The role of the Persian Gulf's natural gas reserves for the European Union's energy security

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The role of the Persian Gulf's natural gas reserves for the European Union's energy security

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In the Name of God

the Compassionate the Merciful

This manuscript is dedicated to:

The Gracious Imam Reza

(Peace be upon to him)

And

The universal Saviour Imam Mahdi

(*May Allah* hasten *his reappearance*)

Abstract

Energy, as a matter of security, is the major challenge during the 21st century. The energy mix in the world will change in the future, predominantly to renewable energy sources, followed by natural gas. Nevertheless, the latter will act as the bridge for the transitional era to the non–hydrocarbon period.

The EU will be the foremost gas importer by 2030 and the rate of LNG imports will double by 2020. The UK, France, Spain and Italy are the main EU entries for LNG imports and approximately 80% of the regional terminals are located in these countries importing 87% of the Union LNG needs. Obviously, the mentioned EU member states will be more influential for the regional energy security in the future.

Diversification of LNG routes and suppliers is an important objective in the EU's energy policy and its security of supply. For this reason, it has already been at the top of the EU's agenda.

The Persian Gulf, as the gas richest area worldwide, holds 40% of global gas reserves. Iran and Qatar, as the potential and actual LNG suppliers, embrace nearly 30% global gas deposits or 75% of Middle East reserves. So, this low–cost/ high–risk region could be influential on the EU's energy security in the future.

Therefore, in the current multi–level analysis consisting of the EU and the Persian Gulf, as the macro and micro levels, the role of the natural gas within the Persian Gulf for the energy security of the EU will be examined. The research, furthermore, aims to analyse the role of the actual Qatari LNG and potential Iranian LNG on the UK, France, Spain and Italy in the future.

This multiple–case study centres on a comparison of different actual and potential LNG suppliers towards the EU, on the basis of testing the four indicators of the energy security, comprising acceptability, availability, affordability, and accessibility. It will finally to determine the position of the Persian Gulf and its main regional LNG suppliers in the future amongst the main global exporters.

Positioned in the intersection of the Persian Gulf and the EU, the existing dissertation pursues a multi–level explanation and analysis of energy–related issues of the both regions and their case–studies domestically, regionally and to lesser extent globally.

In parallel, the study is a detailed examination of the emerging gas and LNG–related challenges and vulnerabilities in addition to investigate the security of LNG supply–related issues, approaches, and policies of the EU and the main suppliers, particularly within the Persian Gulf.

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Abbreviations	**Description**
bcm/p.a(y)	billion cubic meter/ year
BP	British Petroleum
EIA	Energy International Administration
EU	European Union
GCC	Gulf Cooperation Council
IEA	International Energy Agency
IGU	International Gas Union
LNG	Liquefied Natural Gas
MMBtu	Million British thermal units
MMcm	Million cubic metres
MMt/y	Million tonnes/year
OECD	Organization of Economic Cooperative and Development
Tcf	Trillion cubic feet
Tcm	Trillion cubic metre

Country abbreviations

AT	Austria	LU	Luxembourg
BE	Belgium	LV	Lithuania
BG	Bulgaria	NL	The Netherlands
CZ	Czech Republic	NO	Norway
DK	Denmark	PL	Poland
EE	Estonia	PT	Portugal
FI	Finland	RO	Romania
FR	France	SK	SlovakRepublic
DE	Germany	ES	Spain
GR	Greece	SE	Sweden
HU	Hungary	CH	Switzerland
IE	Ireland	TK	Turkey
IT	Italy	UK	The United Kingdom
LT	Latonia	US	The United States

Declaration

I hereby declare that the current thesis, entitled "The role of the Persian Gulf's natural gas reserves for the European Union's energy security", is the result of the author's original investigation, except for those quotations, citations and references that have been duly acknowledged. It was carried out between April 2009 and June 2013 in the Institute for Middle Eastern and Islamic Studies within the School of Government and International Affairs at Durham University. This material has not been previously submitted in application for another degree or qualification to any other institute or university.

Statement of Copyright

Acknowledgement

Praise be to Allah, *Subhanahu Wata'ala*, Lord of the Worlds, Most Merciful, Most Gracious and also peace be upon to his Final Prophet and his impeccable Family and Ahlul-Bayt.

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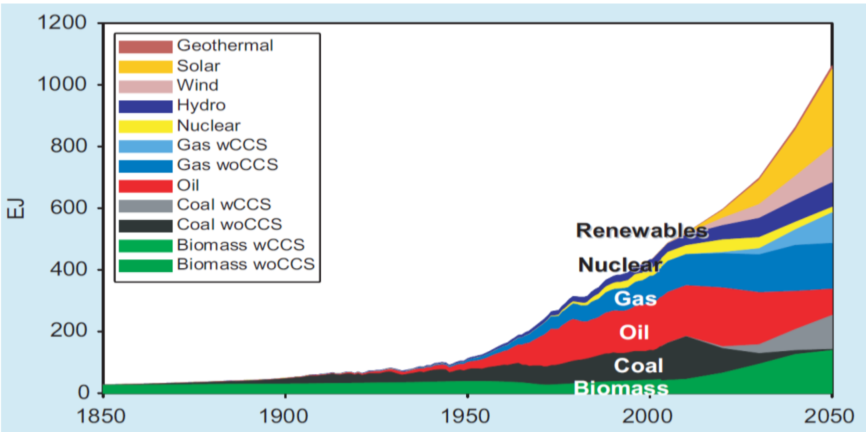
Introduction

Energy has always been regarded as a matter of security (McGowan, 2011: 490), and will be the most significant challenge during the 21st century (Bahgat, 2011: 1&2; Alhajji, 2007), so the energy security would be at the top of the global agenda. Whilst the energy security is traditionally concentrated on oil supply (Cherp & Jewell, 2011: 203), natural gas has increasingly become the fuel of choice (Luft & Korine, 2009: 555; Eurostat 2010: 6); therefore security of gas supply has entered the global energy literature. The global energy mix will change between 2010 to 2030, primarily to renewable energy sources, followed by natural gas (BP 2012, Energy Outlook 2030: 31). As a result, the share of the former rises to around one third of total primary energy sources worldwide, while the latter is the fastest growing fossil fuel globally (figure 1). It seems that natural gas will act as the main bridge for the transitional era to renewable energy sources for global use (Global Energy Assessment 2012: 75). The global natural gas demands will increase by around 50% by the end of the next decade and its share in the global energy mix will rise from 21% in 2010 to 25% in 2030 (IEA Special Report, 2011: 7–8).

Figure 1: Development of total primary energy sources in Global Energy System (GEA), 1850–2050



Source: Book, entitled "Global Energy Assessment–Toward a Sustainable Future", 2012: 76

The EU will be the first gas importer by 2030 (European Commission Working Paper, 2011: 2) and will import around 80% of natural gas needs after 2020 (BP 2012, Energy Outlook 2030: 78–79), however 1.3% of global natural gas reserves are situated in this region (BP 2011) and also it encounters a number of internal and external challenges in this respect. In addition, it is likely that the growing role of unconventional gas and renewable energy sources will impact on the amount of EU's natural gas import in the future.

It is expected that the capacity of global LNG trading will double by 2020 and more by 2030 (CEDIGAZ 2011: 6). The rate of the EU's LNG imports will rise close to 90% in 2020, compared to 2010 and this percentage will increase further by 2030. For this reason, the Union has decided to import LNG, during the next years, more than the current capacity and the current 31 existing, under construction, and under consideration LNG terminals within the region proves this point (annexes 11–15). In addition, 24 of these facilities, roughly 80%, are placed in the UK, France, Spain and Italy and these countries have imported nearly 87% of the regional LNG needs (IGU World LNG Report, 2010: 8). That is because, the mentioned EU members would be more important in the future not only for the Union's energy, but also for the whole of Europe.

Diversification of natural gas and LNG suppliers has also been at the top of the EU's statements from various suppliers regarding future policy (Regulations over EU safeguard security of gas supply, 2010: 2).

The Middle East holds 40% of global gas reserves, approximately all of which are situated in the Persian Gulf (Oil and Gas Journal, 2012), as the gas richest area worldwide with its exclusive features economically, politically, strategically and geo–politically. Iran and Qatar embrace nearly 30% global natural gas or 75% of Middle East gas reserves (M. Wietfeld, 2011: 206) and these two, alongside more four littoral states in the region are among the top 20 natural gas holders worldwide, hence this low–cost/ high–risk region could be influential on the EU's energy security.

Iran, as the Persian Gulf's largest natural gas producer (US EIA 2011: 52), has two main Grand Energy Strategy and Outlook Documents, in addition to the ambitious target of increasing its current 1% share in the gas global market to 8%–10% by 2023 and taking part more actively in Gas Exporting Countries

Forum (GECF). So, the LNG projects currently both under construction and consideration will play an important role in this regard and could put Tehran among the top five global LNG exporters by 2020. However, this plan has encountered two huge impediments (Bahgat, 2010: 333–347). In addition, the EU is amongst the main destinations for the future Iranian LNG export. So, the research deficiency of the dual effects of Iran's LNG supply on this country and also the EU's energy security is apparent.

Demand for gas in Qatar, as the fourth largest gas consumer in the Middle East and Persian Gulf (IEA, Natural Gas Information 2010), has been more than doubled since 2000 as a result of its economic and domestic growth and this will most likely continue in the future (BP Statistical Review of World Energy, June 2011: 27).

The EU's LNG markets have been attracting around 33% of the Qatari LNG (http://www.eia.gov/countries/Qatar), as the leading supplier worldwide in recent years. For the time being, there are two main arguments regarding the future of the Qatari LNG supply. The first insists on the preservation of the current supply, while some Qatari officials have emphasised on this country's leadership in the global LNG market in the future.

In this study, the role of the Persian Gulf's natural gas, in general, and LNG supply from Qatar (actual) and Iran (potential), in particular, for the EU, in general, and the UK, France, Spain and Italy, in particular, will be analysed. Obviously, this supply could impact on Qatar and, in particular, Iran's energy security, too. So, some secondary questions, followed by the main question will be raised.

The independent variable of the non–directional (Creswell, 2003: 111) and descriptive hypothesis is the Persian Gulf's natural gas and its actual, as well as, potential LNG supply, while the dependent variable is the EU's energy security. Moreover, this kind of data collection would be related to the future of energy security and investigating the future events, so the best technique is scenario–building (http://duo.dur.ac.uk/webapps/portal/frameset.jsp).

This multiple–case study is the combination of qualitative and quantitative research and will be descriptive–exploratory (Grix, 2001: 66–67) or descriptive–analytical, methodologically. Therefore, it needs to use both field studies and library research methods or a mixed method on the basis of concurrent qualitative and quantitative data collection in one single phase without any sequence (Creswell, 2003: 211).

Although mixed method will be applied to this research, the data will be analysed more qualitatively than quantitatively, based on deductive approach.

Deductive approach means that the research should be based on fundamental theories. It seems that the most suitable theoretical framework for the EU–27, as the "macro–region" (Farrell et al. 2005: 87–95) and the most integrated region worldwide would be New Regionalism, as the EU's indicators are coincident with the above–mentioned criteria of the theory.

The Subordinate System, as a regional subsystem, would be a proper theory for the Persian Gulf, as the micro and unstructured region as well. In the third stage, the Regional Security Complex Theory could connect these two regions and their theoretical frameworks, so the energy security, as the main connecting factor between the Persian Gulf and the EU in the research hypothesis, can be considered as the sixth element of this theory. Then, the energy security's main indicators should be extracted and be tested on various actual and potential LNG suppliers' relationships with the EU to test the research hypothesis and answer the question(s).

Research Question(s)

According to Grix (2001: 64: 57–60), literature review is drawn in three stages. The first two phases of my literature review will be argued broadly in the chapter one. Nevertheless, in the third stage, some secondary questions have been raised and then by narrowing the focus (Grix, 2001: 64: 57), the main question, as the main gap, will be brought up that has not been asked and answered by anybody else, followed by the research hypothesis.

I plan to find the analytical answers for these "associated sub–questions" in my research before the central question (Creswell, 2008: 112–115), as follows:

- ✓ *How do the different gas–rich regions worldwide impact on the EU's energy security?*
- ✓ *What is the position of Persian Gulf's natural gas reserves, amongst the other areas, on the EU's energy security?*
- ✓ *How do the different actual and potential LNG suppliers impact on the EU's energy security?*
- ✓ *What is the position of LNG export from the Persian Gulf, in general, and also Iran, as well as, Qatar, in particular, amongst the other actual and potential suppliers, on the EU's energy security?*
- ✓ *How will Iran's potential LNG supply in the future towards the EU and also Qatar's LNG development, or at least the maintenance of the current production, influence these two countries' energy security?*
- ✓ *How can the EU secure its natural gas and LNG demands and what role the Persian Gulf plays in the energy securityof the EU?*

Therefore, by combining these secondary questions (Hafeznia, 2010: 117), the main research "descriptive question" (Creswell, 2003: 112) could be raised:

"How might the EU's future energy security be impacted by the development of a comprehensive natural gas export strategy among Persian Gulf states?"

This research is a fresh attempt to answer these main and secondary questions, based on an appropriate theoretical framework, methodology and the methods of data collection that will be explained in this chapter.

Research Hypothesis

The hypothesis of this thesis is: "The Persian Gulf's natural gas reserves, in general, and its actual and potential LNG supply, particularly from Qatar and Iran, could play an important role for the energy security of the EU in the future and also this relationship could also impact on the energy security of the states within the Persian Gulf region."

The "independent" (Hafeznia, 2010: 47) or "explanatory" (Grix, 2001: 9) variable of this "descriptive hypothesis" (Frankfort & Nachmias, 2008: 56–59 and 436) is natural gas deposits within the Persian Gulf and its actual and potential LNG supply, while the "dependent" (Hafeznia, 2010: 48) or "outcome" (Grix, 2001) variable is the EU's energy security.

The researcher has had some predictions prior to the literature review regarding the relations between the two variables and also simultaneous with the initial dip in to the latest natural gas and LNG literature, but the energy security' indicators should be tested on different suppliers to the EU in order to test the hypothesis for confirming or disproving the primary forecasts. As a result, the hypothesis would be "non–directional" (Creswell, 2003: 111).

Methodology, Research Methods and Data Analysis

This "multiple–case study" (Grix, 2001: 67; Hafeznia, 2010: 296) research will be "descriptive–exploratory" methodologically (Grix, 2001: 66–67), as in some chapters, at first, certain historical and the present energy policies and geo–politics issues, particularly within the EU and the Persian Gulf will be considered and secondly, by testing the energy security indicators, including acceptability, availability, affordability, and accessibility, on different actual and potential LNG routes toward the Union (figure 2), followed by the testing the hypothesis, this research precedes the exploratory stage and attempts to find relationships between the two variables analytically (Hafeznia, 2010: 296).

This kind of research methodologically needs to use field studies and library methods (Hafeznia, 2010: 70–75) or "natural language data collection" (http://duo.dur.ac.uk/webapps/portal/frameset.jsp), mostly including interviews, official and primary reports and statistics, as well as archived documents, etc.

Hence, on the basis of this methodology, the data collection methods referred to below have been selected in order to test the hypothesis and finally find the suitable answers for central and secondary questions (Burnham et al.2008: 39).

So, it requires a mixed method (Creswell, 2003: 211), including thematic texts, interviews, primary reports and statistics, in addition to documents, on the basis of "concurrent qualitative and quantitative data collection" in one single phase without any sequence (Creswell, 2003: 211). It seems that this "triangulation" (Grix, 2001: 84) and using more than one method in this research could improve the validity of the results (Grix, 2001: 94).

So, different "descriptive and non–descriptive statistics" (Hafeznia, 2010: 274), having been issued by the main energy organizations (IEA, EIA, BP, CEDIGAZ, The Directorate–General for Energy for the European Commission), ministries (Qatar Petroleum, Iran's Ministry of Petroleum, the related ministries in four EU case studies), institutes (annex 2), etc., as the primary numerical data, as well as some figures, tables, etc., in some books and journals will be used for inferential numeric analysis (Creswell, 2003: 220).

Another method to be employed in this research is gas and LNG expertise and, to some extent, elite interviews that could help the researcher, especially in the exploratory phase of the thesis.

As for the choice of interviewees, various views on natural gas and LNG supply toward the EU in the future from actual and potential suppliers were extracted. So, a number of gas experts, academic personalities and think–tanks have been chosen at the first step, from the case studies within the Persian Gulf and the EU and, in the second stage, from other European countries and the US.

I focused on the energy ministries, institutions and think–tanks in the above–mentioned regions and countries and contacted nearly 90 energy elites, experts and academic personnel. Altogether, 23 interviews were conducted (annex 1) in person, through telephone, email contact or Skype (Burham et al. 2008: 244; Frankfort & Nachmias, 2008: 213–223) over the course of June 2009 to May 2012with these Arabs, non–Arabs and western scholars from Iran, the UK, France, Spain, Italy, the Directorate–General for Energy for the European Commission, Norway, and the US that some of whom have tens of years of experience in the energy and gas fields.

The interviews were conducted as semi–structured predetermined questions (Grix, 2001: 74–77) with five essential questions (annex 4), but in some interviews, based on the situation and the time limitations, some more necessary and desirable questions (Burham et al. 2008: 240) have been raised from respondents or the interviewees to obtain more detailed information in terms of supplementary point(s) regarding the natural gas and LNG issues.

Some of the secondary sources which will be used are as follows:

- Reference and text books regarding the international theories, energy security, natural gas and LNG;
- Reference journals (annex 3), and academic papers;
- Newspapers, news agencies, websites;
- Archives and documentary documents;
- Related maps and tables, extracted from reliable sources;

The researcher will try to gather information and materials which have been prepared by Arabs, Iranian, Western, including European and the US' organizations, ministries, institutes and think–tanks together with authors to avoid any bias.

Operationalisation and quantification of the concepts in the hypothesis, principally the energy security term, in order to measure the indicators shows that the existing thesis is quantitative to some extent. To be analytically helpful, a measure of energy security indicators, comprising acceptability, availability, affordability, and accessibility need to be quantifiable. Therefore, quantitative indicators are necessary to understand the "energy security consequences of different development pathways" (Kruyt et al. 2009: 1).

As the current research is descriptive–exploratory and mixed methods are employed for data collection, so data analysis would be partly quantitative but mostly qualitative for "in–depth investigation" (Hafeznia, 2010: 74–75).

Therefore, in–depth investigation, description, categorisation and finally interpretation, as well as analysis of data (Creswell, 2003: 182) demonstrates that the current thesis is a combination of qualitative and quantitative research that is more suitable for political science and energy issues (Creswell, 2003: 74–77).

Moreover, this kind of data collection would be related to the future of energy security and investigating the future events, so the best technique is "scenario–building" (http://duo.dur.ac.uk/webapps/portal/frameset.jsp); that means what happens in the given context with different possibilities, such as in Chapter 3, regarding different scenarios about the amount of natural gas and LNG import in the future for the EU, or the main three scenarios regarding the amount of Iran's gas export in the future (see details in Chapter 2).

I will analyse the collected data based on coding, demarcating and then summarising them in the form of thematic categorisation and drawing of "descriptive statistics" figures (Hafeznia, 2010: 274), while some of the gathered data needs content analysis, such as interviews. Then it will be necessary to put these coded summarised data into the appropriate themes and, finally, the relationships between them should be discovered interpretively (Grix, 2001: 184), because this method is appropriate for case study researches (http://duo.dur.ac.uk/webapps/ portal/frameset.jsp).

These resources will be used to generate the information to answer the research questions posed in the study and to test the hypothesis.

Ethics in the research

On the basis of the "Reflections on Ethics in Educational Research", issued by Durham University (http://www.dur.ac.uk/r.j.coe/experiments/ethics.pdf), the quality of a research largely depends on ethical issues together with originality.

The author has always endeavoured to observe the ethical principles in his research, particularly in interviews and exact reference–writing for citations, quotation, etc. and also putting the someone else's direct text in quotation marks.

According to the Research Ethics Policy issued by the School of Government and International Affairs at Durham University, Principle 6.b (annex 5), "consent in relation to interview research should be based on simple agreement to participate in the interview process with the right to withdraw at any point".

In the first stage, I explained to the interviewees very clearly who I am, what the topic and the project are exactly about, why I am doing it, etc. This makes for informed consent, meaning they truly understand what they are getting involved in.

It is, moreover, a general ethical principle that participants should be made to feel that they can pull out at any time, without any pressure. Fortunately, none of the interviewees withdrew after expressing their satisfactions to participate in my research and answer to my questions. The collected data used only for purposes specified in my dissertation and my target has been legitimate.

Moreover, I have not disclosed any personal or security data of the interviewees, excluding what they had permitted. These senior scholars have all consented that their responds could be published by the author with the full names, the date of interviews and also the positions of them (annex 2).

Those have been in accordance with the principle 7 of the Research Ethics Policy arguing that "where a guarantee of anonymity is given as part of the process of obtaining consent, this must be strictly observed at all parts of the research process and in written outputs".

On the basis of principle 9, there should be provision for feedback on the results of the research to be given to participants if they request it, unless a justification for withholding is provided. As a result, I have got in touch with some of my interviewees since the first interview in June 2009 to ask them any new question(s) or any unclear point(s) and also convey my new findings to them.

In addition, I have put direct phrases of someone else's text in quotation marks or referenced and also cited the work of the others.

The author has used different primary and secondary resources, such as internet and online sources, and the real references have been brought in bibliography section at the end of the thesis.

The author has also tried to avoid falsifying of data by referencing at the end of each key data and statistics or putting the major figures in the annex section of the thesis. So, the research integrity has been mostly reinforced by accurately recorded data. Likewise, I left my bias out throughout my research and tried to be rational.

Original Contribution(s)

This research is of a primary source character in energy security area and the purpose of this original research is to produce new knowledge in security of gas and LNG supply, rather than to present the existing knowledge in a new form, such as summarising or classifying the previous findings by other scholars.

As mentioned, the "Reflections on Ethics in Educational Research" of Durham University (http://www.dur.ac.uk/r.j.coe/experiments/ethics.pdf) qualifies any academic research in accordance with the ethical issues and its originality.

Grix (2001:108) said that a "substantial contribution to knowledge" means "…you must have produced original research on a given topic and embedded it firmly in the received wisdom of a particular field…" .

Prof. Michael Talbot of the University of Liverpool described the nature of originality with two major elements, comprising facts and ideas, and that both might be either new (never before presented to the world) or old (familiar from earlier commentary), so four possible combinations arise:

1. New facts + New ideas
2. New facts + Old ideas
3. Old facts + New ideas

4. Old facts + Old ideas

He argued that the combinations 1–3 all lead to originality. Only the combination 4 is guaranteed to miss out on originality. Therefore, some new facts that have not been already discovered may become the base of a new idea and development.

In the current research, the author has used the old facts, both in primary resources, such as official reports by international energy organizations, institutes, think–tanks, etc. and also secondary references, e.g. books, journals, etc. Nevertheless, the new facts have been achieved through interviews. As a result, both the categories 1 and 3 with new ideas and achievements have highlighted in this research.

Now, this question is come up that is the outcome of this research really an important step forward in the development or progress of national, regional and global energy security and security of gas and LNG supply knowledge?

Meaningful research is designed to fill up knowledge gap. So, this gap filling requires originality of ideas, theory, method or interpretation of existing theory, leading to contribute to the current knowledge.

The more data to be collected, the higher the chance for a more original work. The author has tried to look beyond the raw data, asking myself some questions, for instance "what does this mean?", or "what if …?",etc.

The current project would be original in the following categories and aims to make a contribution to Iranian energy security, together with regional security of gas and LNG supply.

- Originality in an empirical work: This analysis provides objective results that policy–makers might be able to use as an input to the decision–making process. For this reason, it will be a "practical" research, rather than a "fundamental" one (Hafeznia, 2010: 296). Carrying out an energy policy related problem, particularly the security of LNG supply that has not been done before. Iran has the energy targets by 2023, for instance in gas area, and this research has considered the importance of LNG production and supply by Tehran on its ambitious energy objectives in the future.

- Originality in new conceptualisation of the main theoretical frameworks: The "EU–[GCC+2]" model for energy relations on the basis of analysing of the Cantori and Spiegel's theory, Davidson's model, etc. has achieved.

  While Buzan et al. (1998: 105) believed that the energy policy has been securitised; energy could be added as the sixth element in the Regional Security Complex Theory that affect security. Therefore, the Regional Energy Security Complex Theory has emerged.

- Originality in exploring an unexplored area: Analysis of the old and new facts and data in order to discover a new field of research and extension of the existing knowledge. I have conducted a major investigation in the field of the security of LNG supply from the Persian Gulf actual and potential suppliers to the EU which have never been previously investigated and could be useful empirically, such as the Persian Gulf's LNG supply, in general, and Qatar as well as Iran, in particular, towards the EU in the future and also the security of LNG supply in the mentioned regions on the basis of the four main indicators of the energy security.

  Producing a critical analysis, together with synthesis and investigation of information that have not formerly examined was another aspect of the originality of this research, for example in the area of the security of unconventional gas supply, mainly from the US and its influence(s) upon the geopolitics of the main unconventional gas suppliers in the coming years. This includes interpreting the dataset differently from how it has been interpreted in the existing research literature and also contributes to the current knowledge both empirically and conceptually.

I could not find reference in any work as to why the Persian Gulf gas reserves are/are not able to influence the EU's energy security on the basis of energy security's indicators. Nobody, in Iran, particularly in the Institute for

International Energy Studies and also probably outside this country, has dealt with the role of Iran's potential LNG export for both the EU and this country in the future, as well as the impact of the continued and the future Qatar LNG exports, in addition to the potential of Iran's natural gas and LNG supply on the EU' energy security.

Most researches, especially at Ph.D level, ought to be able to generate at least one, and probably several, journal articles in peer–reviewed and refereed journals. A research article should provide an acceptable claim for originality. If a piece of work is of poor quality, it is unlikely to produce any findings worth publishing. Therefore, I have already extracted four original topics from my doctoral dissertation and definitely decide to publish them in the mentioned journals, as follows:

1. The outlooks of the conventional gas and unconventional gas supply in the future and the impact(s) of the latter on the geopolitics of the Persian Gulf's gas supply;
2. The position of the Persian Gulf's actual and potential LNG supply in the EU energy security in the future amongst the main global suppliers towards Europe on the basis of the energy security indicators;
3. The proposed security model for energy ties and gas supply between the Persian Gulf and the EU;
4. The position of Iran's LNG supply in its energy targets by 2023 and its interaction on this country, as well as the EU energy security.

Value of the work

The current literature in the energy security and the security of gas and LNG supply lacks a comprehensive study on the role of the actual and potential LNG suppliers within the Persian Gulf region for the EU energy security in the mid and long terms, based on the indicators of the energy security, while this relationship could also affect the security of the regional suppliers within the

Persian Gulf. So, his study has a wider perspective than that of existing energy security literature, which helps to make a broad evaluation of security of LNG supply. There have been no such empirical studies made to measure the level of impact of different actual and potential LNG suppliers towards the EU in the future in accordance with the four main indicators of the energy security.

Likewise, the significance of this research stems from the fact that no in–depth empirical study has been already taken in Iran or elsewhere regarding the significance of LNG supply for the energy security of this country and also its grand energy strategy by 2023, while Tehran has been under international sanctions in its energy industries. Moreover, the increasing growth in unconventional gas production in the world could threaten the position of Iran, as an outstanding LNG supplier in the future.

Therefore, this thesis aims to fill in the gap(s) in the existing academic works by exploring in the following arenas:

- ✓ The level of impact(s) of the Persian Gulf's LNG supply, amongst the other regions and countries, on the energy security of the EU in years to come;
- ✓ To what extent the global unconventional gas production, largely by the US, could limit the Persian Gulf's conventional gas supply, as the gas–richest area worldwide and affect the geopolitics of this region in the future;
- ✓ The best proposed security model to ensure the energy security and the security of LNG supply of the Persian Gulf and the EU;
- ✓ The role of Iran's potential LNG supply for the energy security of this country and the EU in the mid and long terms;
- ✓ The position of Iran's LNG supply in its energy targets by 2023.

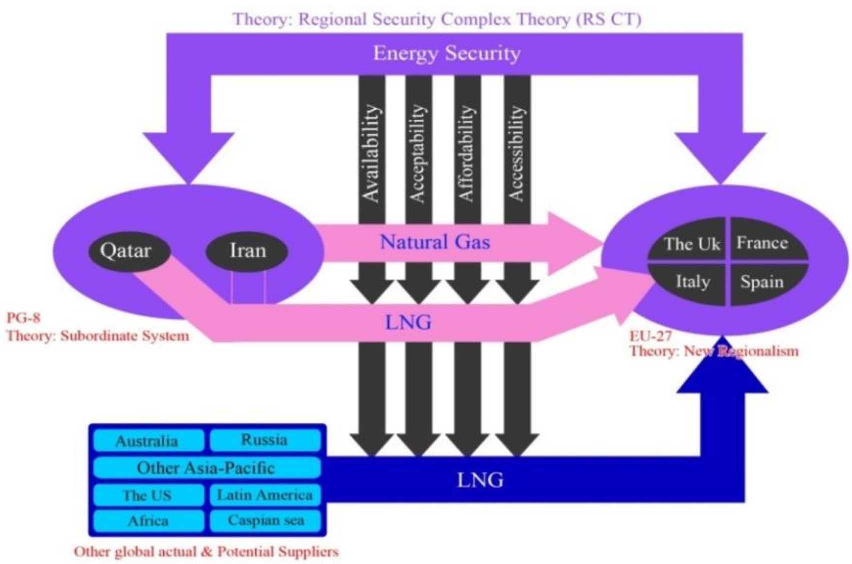
The purpose statement

The author would like to compare different actual and potential LNG suppliers' relationships, including the low–cost/low–risk, low–cost/high–risk, high–cost/

low–risk, and high–cost/high–risk ones, to the EU, on the basis of testing the four energy security's indicators individually and then determine the position of the Persian Gulf's LNG exporters, especially Iran and Qatar, amongst them.

Therefore, the level of units in the current research is "multi–level analysis" (Grix, 2001: 64), while in "macro–level" or structured–centred (Grix, 2001: 64) the role of the natural gas within the Persian Gulf for the energy security of the EU will be considered and in "micro–level" or actor–centred (Grix, 2001: 64) the role of the actual Qatari LNG and potential Iranian LNG on the UK, France, Spain and Italy will be analysed.

Figure 2: The map and the methodology of the thesis



Source: by Author

Therefore, the four extracted energy security indicators should be tested on the LNG relationship between different actual and potential LNG suppliers, such as the Persian Gulf, particularly its two case studies, and the EU in order to test the research hypothesis and answer the main and secondary questions.

The structure of the thesis

This thesis is comprised of an introduction alongside the six chapters, as follows:

In the Introduction part, the main question and associated sub–questions, the hypothesis of the research, the methodology, the data collection methods, as well as the analysis techniques have been discussed. Furthermore, the ethics in the current research, original contributions, value of this thesis, the purpose statement, as well as the structure of that have been mentioned in detail.

In the first chapter, the comprehensive literature review on key concepts, such as energy security, security of gas and LNG supply, etc. have been primarily raised. The terminology of the energy security and its main four indicators, extracted from different definitions, will be completely analysed. This section; nevertheless, includes the introduction of the latest and the existing studies alongside writings as the initial focus, followed by the critical literature review. The deficiencies in the mentioned studies and the importance of this gap have been dealt with in this section.

In addition, the huge amount of collected data has been analysed "deductively", because the data should be employed for testing the research hypothesis, on the basis of one theory or mixture of certain theories (Hafeznia, 2010: 44–46; Frankfort & Nachmias, 2008: 41–42) and, in other words, from one "general theory" to the "particular" finding(s) (Grix, 2001: 39). Therefore, these three applied theories, comprising the Subordinate System, new regionalism, and Regional Security Complex Theory, are explored in greater detail in this chapter.

The second chapter is devoted to the geo–politics of natural gas within the EU, the scenarios regarding the amount of gas demand in the future, as well as the existing and the potential pipelines and LNG routes towards this region. The EU's energy security has been influenced by both internal and external factors that have contributed to anxieties over Europe's ability to meet future gas demand. As a result, the Union has decided to increase its piped gas and LNG imports from the actual and potential suppliers in the future, on the basis of two different scenarios. Likewise, this chapter concentrates on the EU's energy policy, Europeanisation of energy by increasing of the renewable energy sources share in total primary energy sources and analysis of this process in the UK, France, Spain and Italy, while 24 out of 31 LNG terminals currently existing, under construction, or under consideration in the EU, roughly 80%, are situated in these four case studies. As a result, their energy policies, outlooks and the share of natural gas in their energy mix impact on the future EU's gas market.

In the third chapter, the thesis will focus on the geo–politics of the Persian Gulf and common features and disputes amongst the regional states.

In the fourth chapter, the Persian Gulf's natural gas related issues, followed by Iran's and Qatar's gas geo–politics and their grand strategies will be discussed.

The Persian Gulf has some challenges in order to develop its natural gas and LNG industries and more export in the future, such as unconventional gasproduced by the US that will be dealt with in detail in this chapter.

On the basis of Iran's Energy Outlook 2023, this country plans to increase its existing 1% share of natural gas global market to 8%–10% and takes part in GECF more actively, so the LNG projects both under consideration and under construction will play a significant role in this respect, while the EU would be one of the destinations for the future LNG exports. However, this country has encountered two impediments and three main scenarios regarding these two obstacles against its natural gas and LNG projects and exports in the future.

Qatar's economic and domestic growth, as the leading global LNG exporter has accelerated, based on "National Vision 2030 Document" and demand for energy more than doubled since 2000, having turned this country to the fourth largest gas consumer in the Middle East/Persian Gulf. Some officials mentioned that this country does not propose to build any more LNG facilities in the years to come, while some others believe this country could increase its current export capacity to preserve its global position against other competitors.

The potential role of the GECF in the future of natural gas market with attendance of Iran, Russia and Qatar, as the three top global gas holders and its outlook, as well as its challenges are amongst the other issues in the final section of this chapter.

In the chapter five, the main four indicators of the energy security should be tested on the major actual and potential LNG suppliers towards the EU in order to clarify the position of the Persian Gulf among them, followed by the analysis of key findings and discussion.

In the chapter six or final conclusion, the findings of the research will be discussed and the final results and analysis categorised in order to test the research hypothesis, as well as answering the central and secondary questions.

Chapter 1: Comprehensive literature review, terminology of the energy security and the theoretical frameworks

1.1. Comprehensive literature review

The researcher has broadly studied on the topic of the existing research to enrich his understanding of the field. In the phase of general literature review in energy security and security of energy supply, the author has attempted to articulate what previous studies have shown. Thus, a number of main common points have been found that the global energy organizations and institutes, as well as senior scholars have urged on them, stipulating at the end of this section in italic form. This is useful for narrowing down the scope of my reading in the critical literature review stage and establishing the perspective that my research will take.

In the second step, so–called "the critical literature review", the author has tried to investigate the controversies amongst the above–mentioned resources, comprising energy organizations and institutes, in addition to gas experts critically over the major factors that would affect the EU's gas and LNG demands in the future, the role of other potential and actual suppliers, and also how this Union could secure its security of gas supply under these circumstances.

This trend has largely helped me work out where there are gaps in the research, which provided me with a niche for the thesis and finally enabled the researcher to find out how the research could extend and also enhance the studies already done.

Therefore, these arguments have been studied thematically and then a number of results achieved that the researcher will bring all in italic form at the end of the critical literature review section.

Finally, in the third stage of the literature review, as indicated in the Introduction, the author has formulated the six secondary questions to identify the gaps in the literature and also narrow down the research topic and then highlight the main niche of the thesis, as the main research question (See Research Questions section).

As a result, the researcher has divided this part in three separate sections, encompassing general or initial dip in literature review, critical literature review and also the gap(s) and secondary questions (Grix, 2001: 64: 57–60) in order to raise the main research question.

The current dissertation; moreover, has deductive approach, rather than inductive, from a number of general theories to particular points. It means that the research should be based on basic theories that will discuss in this chapter comprehensively.

1.1.1. Initial Dip and General Literature Review

Energy is the "lifeblood of civilisation" and the backbone of all economies for more growth and development (Proedrou 2012), as a "crucial entry point" for dealing with the global challenges during the 21st century (Global Energy Assessment, 2012: 92), as the energy century (Peimani, 2011: 1), while Prof. Peimani believes that energy will be "the single major challenge" for the current century, because of its direct connections with major social, economic, security and development goals, such as sustainable development, poverty eradication, adequate food production, climate change, peace and security (Global Energy Assessment, 2012: 1). This is because Charles Doran (2008) reiterates that "Energy is at the heart of the world politics". It has also played a key role in the development of human civilisation (Bahgat, 2011: 1). The geo–politics of energy resources has been a strategic concern for both exporting and importing states, so the progressive dependence of developed and new emergent economies on energy supply and also confrontations in core areas has placed energy at the top of their geo–political agenda (O'Tuathail, 2006: 205–206).

So, energy has always been as a matter of security (McGowan, 2011: 490), while Felix Ciuta (2010: 136) believes that energy security means the security of everything and Alhajji (2007), as well as Prof. Bahgat (2011: 1) have introduced it as a major challenge in the world in the 21st century (see in detail in Chapter 5).

Energy security is traditionally focused on crude oil supply by the end of the Cold War (Cherp & Jewell, 2011: 203), but since the 1990s, natural gas has increasingly become the “fuel of choice” (Luft & Korine, 2009: 555; Eurostat 2010: 6), so and additional term has entered the global energy literature, so–called security of gas supply (Luft & Korine, 2009: 555).

The global energy mix will most likely change between 2010 to 2030 and the most important change will relate to renewable energies, followed by natural gas. The former will demonstrate a dramatic shift, so BP in its Energy Outlook 2030 (2012: 12) estimates that the share of this non–hydrocarbon will rise to around one third of total primary energies consumption by 2030. On the other hand, the latter is the fastest growing fossil fuel globally (BP 2012, Energy Outlook 2030: 31), unlike crude oil and coal (BP 2012, Energy Outlook 2030: 11).

Global Energy Assessment (GEA) Writing Team in its latest work (2012: 75) explained that under the proper conditions, the share of renewable energy sources in global energy mix will be 35% to 70% by 2050, while decarbonisation in the electricity could be 75% to 100% by the middle of the 21st century. According to this assessment, natural gas is the major bridge or transitional technology in the short to medium term for total accessibility to renewable energy sources global use.

According to BP (BP Statistical Review of World Energy, June 2011), global gas production was 86.86 tcf and 115 tcf, in 2000 and 2010 respectively, but this number will increase at least to 133.8 tcf and 168 tcf by 2020 and 2030 (US EIA 2011: 50).

So, the share of natural gas in the global energy mix will rise from 21% today to 25% in 2030, due to its technological, transportation, economic, as well as environmental characteristics, compared to other fossil fuels (IEA Special Report, 2011: 7–8).

It seems that natural gas consumption and demand will grow at faster rates than other fossil fuels in the future, according to different official statements, such as the IEA in its special report in 2011, entitled "Are we entering the Golden Age of gas?", OPEC Energy Outlook (2011: 54), and the US EIA (2011: 43), so based on BP Statistical Review of World Energy (2011: 4 & 49), natural gas demand increases from 111 tcf in 2008 to 168 tcf by 2030 globally.

While the role of natural gas will increase compared with other fossil fuels, the rate of import will differ from each other. Natural gas consumption in the EU has grown from 18% in 1990 to 24% in 2009, based on BP Statistical Review of World Energy, June 2011, and this region will be the foremost importer worldwide until 2030 and will import around 80% of gas needs until then, followed by new–emerging economies, like China and India (BP 2012, Energy Outlook 2030: 78–79; European Commission Working Paper, 2011: 2), so energy security within the EU means "security of gas supply" (CER, 2011: 83; Luft, 2009: 555). Moreover, the US is the leading gas consumer worldwide, but after more production of unconventional gas, this country will be self–sufficient in importing (see details in Chapters 2&5).

Francesc Morata and Israel Solorio Sandoval in their published book, entitled "European Energy Policy, An Environmental Approach" in 2012, referred to Energy as a foundation of European integration after the Second World War and a continuous matter for the Union influencing its security, while "it is essential to the daily lives of every European" (EU's Green Paper 8th March 2006: 4).

BP in June 2011 also announced that by the end of 2010, EU held 1.3% of global natural gas reserves and according to EIA outlook published in 2011, the largest decreases in regional reserves throughout the world took place in the EU, so more than half of these reserves have been extracted (see details in Chapter 3: Geo–politics of EU's indigenous natural gas); as a result, this union's natural gas imports will rise from 64% in 2009, up to 80–90% by 2020 (Eurostat 2010) and, apart from Norway, as the non–EU country, gas production not only within this Union but also in OECD Europe has been in decline (US EIA, 2011: 51). Consequently, while the EU's gas production in 2000 was close to 232 bcm, however this number reached to close to 175 bcm in 2010, equal to 5.5% global natural gas production, and will reach 165 bcm, as well as, 113 bcm in 2020 and 2030, respectively. Moreover, the EU will be affected by some external factors, such as more demand by other countries and regions, even the Middle East, North Africa and, in particular, the emerging economies (see details in Chapter 3).

It has not been observed in any scholar's book, essay, working paper, energy organization or think–tank's report, etc., in the "initial dip within the energy literature review" (Grix, 2001: 56) that a contrasting position will result in that the role of natural gas in the world and also within the EU might decrease!

Therefore, in the first step of the literature review, the major common points of the studied writings and reports can be summarised and categorised, as follows:

- ✓ *Natural gas demand will grow at faster rates than for other fossil fuels in the future;*
- ✓ *Competition among the major importers as the attraction of natural gas increases;*
- ✓ *The EU will be the foremost natural gas importer worldwide until 2030;*
- ✓ *The rate of LNG trading will grow more than piped gas.*

1.1.2. Critical Literature Review

By the investigating of different works, presented by gas specialists, institutes, etc., I have found that there are two main arguments among researchers, affecting the rate and the amount of EU's gas import in the future: the growing roles of both unconventional gas and renewable energy sources.

In this second step after the initial dip and general literature review in to the current gas literature review, I plan to study these "controversies" (Grix, 2001: 61) more critically as "the critical literature review" (Grix, 2001: 60) and use "thematic approach" (http://duo.dur.ac.uk/webapps/portal/frameset.jsp) for examining these literatures, rather than chronologically.

In the first stage of the thematic literature review, I will bring different views regarding the impact of unconventional gas and renewable energy sources on the volume of required natural gasand LNG which is critically important for the future of the EU.

Some energy experts count the unconventional gas as a serious rival for the conventional gas during the next two decades as "the unconventional gas revolution" (IGU World LNG Report, 2010: 23). They argue that this "game changer", according to Bahgat and "energy revolution", on the basis of Davidson's comment, could reshape the global natural gas and LNG systems, especially in North America, providing that the US will no longer need to import LNG over the next decades, and that other countries could replicate the experience of the US (IGU World LNG Report, 2010: 9). Bahgat (2010) and Prof. Giacomo Luciani in their writings and interviews, have insisted on this point.

However, there is another argument that, while unconventional gas will grow more in the future, the position of conventional gas will be still in place.

S.A. Gabriel and his colleagues (2012), as well as Zhi Ying. N (2012) argue that unconventional gas faces the future with some constraints, such as environmental, financial, ecological and infrastructure.

The Energy Director–General within the European Commission in its final report on unconventional gas in Europe, published on 8th November 2011, confirmed these points. It focused on shale gas, compared to tight gas and coal–bed methane, because this kind of experience for unconventional gas exists relatively less in Europe, but argued that "no commercial scale shale gas exploitation has taken place yet and it is only expected in a few years time".

Lochner and David (2009), drew attention to this point regarding unconventional gas in North America, taking effect on the short–and mid–term development of the North American gas market, however they believed that its influence on the long-term are expected to be smaller, mostly because of the costs involved.

Apart from the above–mentioned restrictions, production of unconventional gas is expected to grow from 13 tcf in 2008 to 31 tcf in 2035, in particular in the US and Canada and, to a lesser extent, in Russia, China and the EU, however global gas production will be to around 170 tcf until 2035 (EIA International Energy Outlook 2011: 50).

It could be concluded that, notwithstanding some of the energy experts counting the unconventional gas as a serious rival for conventional gas during the two next decades, particularly in North America, that conventional gas will preserve its full supremacy on the global gas market at least until 2035 and, by analysis of certain official statistics issued by international energy organizations and institutes, it could be illustrated that the percentage of unconventional gascompared to conventional gas will be 17.95% by 2030 while this number was 12.5% in 2010 and will be 15% in 2020.

On the basis of official statistics issued by BP Statistical Review of World Energy (2011: 4&49), global natural gas demands will increase from 111 tcf in 2008 to 133 tcf and 168 tcf by 2020 and 2030, respectively. These figures show that global gas demands will grow by nearly 50% until the end of the next two decades and then gas producers should increase their supplies by almost 50%, while unconventional gas will grow under 18%, and it shows demand for conventional gas in next decade(s) is more than 2010. For instance, according to CEDIGAZ in its report in 2011, the EU imported 86.25 bcm/y of LNG in 2010, while this volume must increase to 160.8 bcm/y by 2020 (see details in Chapter 3).

In addition, most of the produced unconventional gas in North America should be consumed domestically, so, in 2035, unconventional gas will provide 24% of the consumed natural gas in the US, up from 6% in 2008 (DOE–IEA, Annual Energy Outlook 2010: 3; see details in Chapter 4: unconventional gas as a rival for Persian Gulf's conventional gas), while Luciani and Bahgat believe that by the US' having more self–sufficiency in gas production, the previous volumes of gas exported to this country, can move elsewhere.

Luciani indicated to the point of “any unexpected events in the future” for the increasing demands of natural gas and LNG, such as what happened in the Fukushima Daiichi disaster, in Japan in 2011, which caused the huge amount of LNG to flow to the Far East and, of course, led to raise demands for LNG.

The second point that could be influential on the amount of imported piped and LNG towards the EU in the future, in some energy scholars’ words, would be the rate of progress in renewable energy sources technology, particularly the degree of fulfilling of the 20/20/20 targets by 2020, based on its commitment regarding the Kyoto Protocol, in order to achieve the “Europeanisation” of energy, according to the Energy Summit of the European Council on 4th February 2011 (see Chapter 2).

According to the EU’s Road Map for 2050 (2011: 2) and the “renewable energy sources Roadmap” (European Commission 2007a), renewable energy sources share in energy mix should rise by 20% until 2020.

Prof. Gonzalo Escribano (2011: 39–59) tried to explore an energy strategy with a geo–economic approach for the EU that could integrate the tensions between geopolitics and the market in a coherent external EU’s energy policy. Then he, alongside his academic colleagues in the newly–published book (2012), believed that the EU could deal with the new strategy and approach, as the Europeanisation of energy corridors to this Union (2012: 276). Then in chapter 15, he and his colleagues put the European renewable energy sources corridors and cross–border renewable energy sources flows, like solar plan from Mediterranean countries, could be influential on the EU’s energy security, but with conditions. Escribano considered this new approach as a choice for the EU energy supply in the future, while the difficult economic situation since 2007, political instability in the Middle East and North America, and also rising energy consumption in the emerging countries have pressurised the Union’s energy market and its tensions, like price volatility, increased and might continue to increase in the future.

Nevertheless, some EU and non–EU institutions, high–ranking officials and energy experts acknowledge that the share of 20% renewable energy sources in the Union energy mix until 2020 and also energy efficiency targets would be less likely and should go beyond that and even to 2050.

The EU Commissioner for Energy said that the Union will obtain only 9% in energy savings instead of 20% by 2020 (Oettinger, 10th November 2010: 2).

The US' Congressional Research Service (CRS); moreover, in its recent report issued on 13th March 2012 argued that the EU's growing needs to shift fuels to more decarbonisation is a major energy challenge for the future (CRS Report, R42405, 13th March 2012).

Dr. Gal Luft, and Dr. Anne Korine (annex 1) in their book (2009: 565) argued that the EU could not solve its energy problems just with renewable energy sources and energy efficiency and Rafael Kandiyoti (2008: 235) discussed that these non–hydrocarbons are not a comprehensive solution in the short– and mid–term for the EU.

That is because; Proedrou Filippos (2012) argued that energy security and energy policy in the EU should be based more on hydrocarbons, especially natural gas in the future, despite growth in renewable energy sources consumption.

He added that the relatively high price of renewable energy sources technology simultaneous with the economic crisis is the main reason behind the slow growth of renewable energy sources in the Union energy market. O'Tuathail and Dolby (2006: 210–211), analysed that not only renewable energy sources, but also other non–hydrocarbons, such as bio–fuel, solar, nuclear, etc., could not replace hydrocarbons on a significant scale during the next few decades.

According to Eurostat Statistical Book, ISBN 1831–3256 (2009: 126), most of the EU's member states have a long way to go to achieve the renewable energy target for 2020, while 16 out of 27 should promote their own renewable energy sources use between 200% to more than 1250% by the end of the current decade and need around €1 trillion investment by 2020 (EU's energy 2020: 2; CER 2011: 7; CRS Report, 2012).

This has been the point that Prof. Hooman Peimani (annex 1) in his newly–published book (2011) made that renewable energy sources are yet to become a serious alternative to hydrocarbons due to the lack of sufficient investment (see details in Chapter 2: the EU's energy policy).

R. Odell (2002) stipulated that the European market for gas is in an "expansionist mode", while this involves a nearly 100% increase in gas use in Western Europe and 150% rise in the east of this continent by 2025, compared to 1995.

It is obvious that natural gas is too crucial for the EU's energy security in the future; nonetheless, different institutes and energy personalities, e.g. the European Commission's Directorate–General for Energy and Transport, CIEP (Clingendael International Energy Program), Eurogas, OME (Observatoire Méditerranéen de l'Energie), Eurostat, and CEDIGAZ, have raised a few scenarios regarding the volume of imported natural gas and LNG in the future, including "High growth in gas demand" by little growth of renewable energy sources and also "Low growth in gas demand" after increasing growth of renewable energy sources share in the EU energy mix (see details in Chapter 2).

By analysing these energy institutes, this result could be achieved that the EU should import 550 to 670 bcm/y just until 2020, based on low and high demands within this region, based on how the EU implements its energy efficiency and renewable energy sources policies, while European gas production will be around 130 bcm/y, excluding Norway (see details in Chapter 2).

Consequently, in this critical phase, as the second step of the current gas literature review (Grix, 2001: 60–62), and by "hierarchy of evidence of this literature" (http://duo.dur.ac.uk/webapps/portal/frameset.jsp), these results will be achieved: (see details in Chapters 2 & 5).

- ✓ *The unconventional gas holds under 18% of global gas production by 2030 and more than the other 82% belongs to the conventional gas;*
- ✓ *The global gas demands grow by nearly 50% by 2030, so gas suppliers must produce 50% more, while unconventional gas could cover nearly 18% of this growing production;*
- ✓ *The EU imported 64% of its needed gas in 2009 and this percentage will rise to 80% after 2020;*
- ✓ *The renewable energy sources target by 2020 is ambitious, while 16 out of EU–27 should promote their own renewable energy sources use between 200% to more than 1250% by 2020 and it needs €1 trillion investment;*
- ✓ *The rate of the EU's LNG imports will rise close to 90% in 2020, compared to 2010 and this percentage will increase further by 2030 further;*

So, the importance of diversification of gas suppliers has much significance for the EU, particularly after the gas dispute with Russia in 2006–2009, led to disruption of supply. Ariel Cohen in his essay, published by Heritage Foundation in 2006 wrote that "The North European Gas Pipeline threatens Europe's energy security, because Russia builds a strategic new pipeline to Europe that will affect energy security in this continent for years to come, this direct link has the potential to increase the dependence of the EU on Russia."

Malcolm Wicks, the British ex–Energy Minister and the current parliamentarian in some of his work (2009), insisted on the importance of LNG trading for the EU, particularly over long distances, while diversification of LNG suppliers and its flexibility over destination would be critical to ease some various supply risks, such as might exist with the Russian domination of the EU's gas market.

On the other hand, Pascual and Zambetakis in the chapter of "The Geopolitics of Energy From Security to Survival" in the book, entitled "Energy Security: Economics, Politics, Strategies, and Implications" (2010: 21) argue that diversification of suppliers and LNG routes is costly and needs construction process.

Any opposite arguments have not been found yet, while all believe that the EU must diversify its natural gas and LNG import routes more in the future.

John Gault, the President of the Energy Project Development in Geneva, in his two essays (February & November 2004), discussed this point and concluded that "in the future, most of the resources from the Persian Gulf will be drawn toward faster–growing markets in Asia, so the EU will compete with China and other Asian markets for gas from the Persian Gulf's reserves".

He has also explained that the EU remains vulnerable to the threat of gas disruption from Russia.

Sascha Muller–Kraenner in his work, entitled "Energy Security: re–measuring the world" in 2007, argued that Russia, Caspian, as well as Middle East/Persian Gulf regions are situated in the "Strategic Ellipse". He continued that the Union should more actively compete with other thirsty gas importers during the "Great Game of the 21st century" by diversifying of the "Trans–European energy networks". Sascha cited to the Commission's study that competition with the main gas importers worldwide will become tougher in the future.

The author of the above–mentioned book has finally raised the three focal questions that the EU should find proper answers in order to more security of gas and LNG supply in mid and long terms, as follows:

1. How to structure the relations with Russia?
2. Will Iran successfully be integrated into the international system and global economy?
3. Is Turkey to become a member of the EU?

On the other hand, Richard Young, moreover, in the book of "Energy Security: Europe's New Foreign Policy Challenge" publishing in 2009, believes that the EU has been slow in competition with its global rivals to draw more energy. Therefore, he advised that the Union should concentrate further on the mentioned ellipse with its less–stable countries.

He indicated to the Extractive Industries Transparency Initiative that a small number of the EU member states have already approved it and most of the European countries opposed to exert strong pressure on the main gas producers and exporters in the “Energy Ellipse”. So, he concluded that while the EU supports governance reforms, more democracy, as well as human rights in energy producers as an approach to its energy security, but energy and democracy–related decisions was disconnected from each other.

Anthony Cordsman in his book, “The role of Europe in the Middle East”, believes that the energy sources in the Middle East, especially in the Persian Gulf, will influence on the EU until 2020 and beyond.

Dr. Sanam S. Haghighi (2007), believed that the current energy agreements between the EU and main suppliers, including Russia, the Mediterranean and the Persian Gulf's countries could not secure all required demands in the future, so the Union should move towards both bilateral and also regional negotiations and agreements with the main gas holders.

Dr. Mehdi Parvizi Amineh from the International Institute for Asian Studies, the International Energy Program in the Netherlands, in his various writings, such as “Globalization, Geo–politics and Energy Security in Central Eurasia and the Caspian Region” and Prof. Abbas Maleki, from MIT University, the US and the Iranian ex–deputy Foreign Minister, in his work (2007), pointed out to the role of the Caspian Sea and the Persian Gulf's gas reserves for not only the Union but also for global energy security, while Europe is surrounded by a “sea of gas”.

Construction of new pipelines and also LNG will be essential to ensure access to the gas–rich regions, especially in the Caspian Sea, the Middle East/Persian Gulf and Africa. This has been insisted in some European statements, like the Green and White Papers, as well as the EU's energy charter. (Green Paper, 03rd August 2006)

In summary, the key element of the EU's energy supply strategy is to shift to a greater use of natural gas, compared to other fuels and this point has been emphasised by not only the Union's main bodies in their approved statements and actions, like the establishment of the Gas Coordination Group in May 2006, Green Paper on security of supply (2000: 44), "Energy Action Plan for 2010 to 2014" on 6th April 2010, Regulations over EU's safeguard security of gas supply in 2010, but also in ultra– regional distinguished institutes, such as CRS Report 2012. Hence, natural gas could be the "Achilles heel of the EU's energy security", according to Herbert Ungerer, Deputy Director General, DG Competition (2007: 2).

Natural gas can be transported both in the form of piped gas and liquefied. LNG is more globalised than pipeline (C. Schofield, 2011) and now accounts for 30.5% of global gas trade (BP Statistical Review of World Energy June 2011: 4). The number of exporters, moreover, has increased from 13 in 2005 to 18 in 2010, under 40% growth, while the figure of importers rose from 11 to 22 countries, around 200% increase, during the same period, according to IGU in 2010.

It is expected that the capacity of LNG trading will increase from 270 bcm in 2008 to 450 bcm in 2015 and 540–566 bcm in 2020, according to IEA Special Report (2011: 45), as well as CEDIGAZ's report on 24th June 2011. So, most of this volume flows to the Asian and newly–emerging economies in this continent, followed by the EU, according to the report by CEDIGAZ, as well as BP Energy Outlook 2030 published in 2011. The latter report added that the LNG trade grows twice as fast as global gas production.

Europe's gas imports are nearly 81% delivered by pipelines (Eurogas Statistical Report: 2010), whereas the situation in the EU's natural gas market has changed considerably over the last few years, so Europe's LNG regasification capacity has almost tripled in just 6 years (CEDIGAZ, Statistical Database) and the share of LNG in this region's total gas trading will expand from almost 15% in 2010 (CEDIGAZ , 24th June 2011) to more than 24% by 2020, according to the EU Energy Commissioner (Oettinger, 2010: 5–6) and 40% by 2030 (BP, 2011: 57; see details in Chapter 2: External LNG routes toward the EU).

Luft and Korine (2009), in addition to Pascual and Zambetakis (2010: 21) argued that the LNG producers and consumers can establish a special relationship directly without any transit players and this interdependency, according to Cindy Hurst (2009), will increase the security of supply, as well as local, national, regional and global energy security.

I have not found any book, journal, working paper, etc. that reject the fact of the growing demands of LNG within the EU, but they do discuss issues of import volumes in the future.

Luciani (2012) argued that the EU's LNG in the future depends on "the level of economic growth in the Union, shifts to nuclear, renewable energy sources and even coal and also on the potential for domestic gas production from unconventional gas sources. Nevertheless, Laura El–Katiri (annex 1) added winter weather conditions and peak demand to these elements.

As a result, the EU decides to increase its LNG capacity import during the next years by 31 existing, under construction, and under consideration LNG terminals so that 24 out of which, roughly 80%, are placed in the UK, France, Spain and Italy, while nearly 87% of LNG is imported by the UK, Spain, France, and Italy, equal to 25% of the world's LNG import, according to IGU (World LNG Report, 2010). So, these four countries will be more important in the future not only for the Union, but also for the whole of Europe, while for the time being, there are two online terminals, operating in just non–EU Turkey and the three proposed terminals in Croatia and Albania (see further details in Chapter 2).

Hence, I have chosen the above–mentioned countries as my case studies within the EU.

Inge Bernaerts, the Head of Unit, Electricity and Gas within the Director General Energy, the European Commission (annex 1) argued that it is difficult to foresee how the current LNG import by EU and also suppliers will continue or change in future, while the quantity of LNG imported in the EU from Qatar has been constantly increasing during the past years. He believes that, "the choice of suppliers stays with commercial entities and is not steered by EU institutions.

The role of institutions is to create a stable, clear and predictable legislative framework, so that energy and gas companies can adequately plan and realise their investments."

R. Odell (2002) explained that under the growing demand contexts within the EU, the cost of longer–run supplies could become a critical variable in the future.

Hartley and Medlock (2006: 407–439), compared various gas holders worldwide, while they believed that the South American gas suppliers will be neither a gas importer nor exporter and, unlike Australia, some of the gas exporters within the Association of South East Asian Nations (ASEAN) will be amongst the major exporters by 2025 and after that they will probably convert to importers. They acknowledged that Russian pipeline and Persian Gulf's gas would be critical in the future, particularly for Asia and Europe.

James Baker Institute at Rice University, the US, issued the World Gas Trade Model (BIWGTM) and analysed the future of global natural gas and LNG markets and concluded that due to growing gas demand by 2040, as well as decrease or depletion of gas resources in many areas during the next decade, the main gas holders, like Qatar, Iran and Australia will hold around 50% of global LNG export in the future, while the first two countries could play an important role to connect the regional gas markets for a more globalised gas trading system.

Lochner and Bothe (2009) argued that because of Europe's LNG demands, particularly from 2020, the main gas holders within the Middle East/Persian Gulf and North Africa will be much more important.

The Middle East holds 40% of global gas reserves, while nearly the whole of these deposits are situated in the Persian Gulf, as the richest gas area worldwide. For this reason, both the Middle East and the Persian Gulf should be considered with each other throughout this thesis, so–called the Middle East/Persian Gulf. Iran and Qatar embrace nearly 30% global natural gas or 75% of Middle East gas reserves and these two, alongside more four littoral states in the region, are among the top 20 natural gas holders worldwide, according to EIA International

Energy Outlook 2011: 33 and 64, BP Statistical Review of World Energy, June 2011, BP, 2010: 22 and Oil and Gas Journal Statistics on 1st Jan, 2011.

The least–expensive, after abundant, is the second feature of the gas production within Luciani's chapter 11 (2012: 236–259). He argued that the low price of natural gas within the Persian Gulf, in addition to other factors, has resulted in Saudi Arabia being less interested in exploring and increasing its natural gas production capacity.

Peimani (2011), Howard Rogers (annex 1), Lochner and Bothe (2009), Prof. Bahgat (2011: 13–14) all believe that the field size and the amount of natural gas in the region, particularly in shared fields between Iran and Qatar, lead to the lowest production costs.

Prof. Paul Rogers (annex 1) mentioned (2012) that the price of natural gas is significant in the future; for this reason the importance of some cheap gas holders, particularly within the Persian Gulf, in the future terms are two–fold (see details in Chapter 4 and, especially, Chapter 5).

However, the Persian Gulf region has some challenges in order to develop its natural gas and LNG industry appropriately and to increase exports during the next years (see details in Chapters 3 and 4; Persian Gulf challenges against its natural gas outlook).

The low–cost/high–risk Persian Gulf is a relatively unstable region and most of the problems regarding the future of natural gas and LNG export from this region are based on this fact.

M. Wietfeld (2011) who previously worked in Qatar and some other Sheikdoms' top gas institutes and official organizations for a couple of years, raised this question of why the Middle East/Persian Gulf with 40% of global reserves produces just roughly 12% of global production.

He, then, in referring to this challenge added further queries. Michael Bauer (2011) believed that mistrust and the zero–sum game is the major regional challenge. So, Mert Bilgin (2009) examined different gas corridors towards the

EU and concluded that the Union should prioritise the Republic of Azerbaijan's gas, followed by Iraq and Iran, because of more political disputes within the Persian Gulfthan the Caspian Sea. He, of course, believed that more LNG supply in the future could ensure the Union's energy security further (see details in Chapter 4: Persian Gulf challenges against its natural gas outlook).

H. Hayes and G. Victor (2006) suggested that the GIRI (General Investment Risk Index), based on the internal situations within gas holder countries, the number of transit countries in piped gas and checkpoints in LNG routes, any risk in consumers, and geopolitical relationships, with a couple of elements on the basis of the ICRG (International Country Risk Guide) could help greatly to measure the degree of risks among different countries and regions with gas deposits. PRS Group Inc., moreover, with its regular publications will also assist the researcher very much (see details in Chapter 5: Accessibility).

While nearly 30% of global natural gas or 75% of Middle East/Persian Gulf are situated in Iran and Qatar, these two countries definitely consider the best ways in order to utilise this potential most appropriately, as has happened in Qatar.

Iran has a non–deniable geo–political position, while Rogers (2012) explained that Iran's geo–strategic importance is primarily based on its oil and gas deposits, as well as the only bridge between the Middle East/Persian Gulf in the south and Central Asia in the north, with over half of the world's known hydrocarbon reserves.

Prof. Pirouz Mojtahed Zadeh (annex 1) in his book (2010: 268) counted Iran as the short and cheap energy corridor for the Caspian and Persian Gulf basins in their aims to transfer gas to the Indian subcontinent, Far East, Europe and Africa. He believes that the Persian Gulf is in the middle of the way between the two main gas importers, including Asia and Europe.

That is because Kemp and Harkavy (1997: 111) defined Iran at the centre of the "Energy Ellipse". They added that the resources of the Caspian Sea basin should be considered together with those that are in the Persian Gulf, so the "Persian

Gulf–Caspian Energy Ellipse" has become "one of the most significant geo–strategic realities of our time."

This country possesses 17.3% of the known global reserves, while 62% of these deposits remain unexploited (US EIA, 2007 & BP, Statistical Review of World Energy, 2009). More than 68% of these reserves are located off–shore and 85% of them are non–associated gas. The South Pars, as the largest non–associated gas field in the world, is the name of the Northern portion of the joint field with the Qatari North Dome.

Based on Iran's "20–Year Outlook Document (2005–2025)", followed by "Iran's Grand Energy Strategy by 2023", this country plans to increase its current 1% share in the gas global market to 8%–10% by 2023 and takes part in GECF more actively, so LNG projects will play an important role in this regard. Tehran has some LNG plans under consideration and under construction with the aim of being among the top five global exporters by 2020, but it has encountered two impediments, including foreign sanctions and increasing domestic demand, while Iran is the Middle East/Persian Gulf's largest natural gas producer (US EIA 2011: 52). All of the scholars, as well as officials confirm these two obstacles, so on the basis of them, three scenarios could be perceived for the country's LNG projects and export in the future (see details in Chapter 4: Iran's three major scenarios regarding the two impediments).

Regarding the second hindrance, Iran's Majlis (Parliament) on 5th January 2010 ratified the subsidy reform plan aims to bring gas prices to the real market level by the end of the fifth development plan, 2010–2015, leading to phase out subsidies gradually, so high domestic gas consumption in Iran, has started to ease since 2010 (BP Statistical Review of World Energy, June 2011). However, foreign sanctions are still in place.

Aarts and Van Duijne (2009: 74), Amineh and H. Holman (19th July 2010: 60) and many other top researchers, in addition to certain Iranian high–profile energy officials, explain that any rise in Iran's gas production is related to the structural industrial and technological changes, so it needs to attract almost

$200 billion of investments by the end of the Five–Year Development Plan in 2015.

Luft and Korin (2009: 13) argued that without LNG there would be no way for Iran to sell its gas to some far–distant importers in the east like China, and to the west, like the EU's countries, in order to increase its share in the global gas market in the future.

Peimani (2011) believes that "the EU does not take advantage of shortage of Iran's gas capacity, while the Asian markets attract most of the global LNG in the future."

Most of the Iranian top officials and energy experts acknowledge the importance of LNG industry for the country's gas policies and the seven liquefaction projects prove it. According to the European Commission, Director General Trade's report on 27th March 2012, 90% of Iran's exports to the EU have been energy related and this country, without considering the recent oil sanctions, is the EU's 6thlargest energy supplier, so Tehran has decided to expand these energy relations to LNG exports in the future and is studying this project in the Ministry of Petroleum and its main affiliated, the so–called Institute for International Energy Studies (IIES). However, foreign sanctions against Tehran put these vital projects on hold (see details in Chapter 4: LNG projects in Iran).

Qatar's "Gas Strategy" caused a shift from oil to natural gas, basically LNG, with 13.8% of global known reserves and converted this country to the top LNG exporter worldwide and its LNG export has been more than doubled between 2008 and 2011 towards Asia, Europe and even South America (Platts, 4 July 2011: 25). The EU's LNG markets including Belgium, the UK, Italy, and Spain have been attracting around 33% of the Qatari LNG destination in recent years, based on EIA's report regarding Qatar.

Qatar's economic and domestic growth, on the other hand, has accelerated and demand for energy more than doubled since 2000, according to BP Statistical Review of World Energy (June 2011: 27), and will almost certainly move further ahead in the future, while this country is the fourth largest gas consumer in the

Middle East/Persian Gulf, on the basis of Natural Gas Information 2010, issued by IEA.

Luciani (2012), indicated this point, that economic growth is always accompanied by growth in energy demands and some other GCC[1] countries, except Qatar, face a shortage of gas for domestic purposes and their development, like the United Arab Emirates and Oman.

So, Qatar attempts to put an end to the enormous subsidisation of local energy prices and aims for more conservation, as well as uses gas for its development more, based on "Qatar's National Vision 2030 Document". However, there are some who predict, including certain researchers at Oxford Institute for Energy Studies (OIES), e.g. Laura El–Katiri, and also the US EIA in its report, entitled "Country Analysis Briefs: Qatar", January 2011, that Doha might have some problems in the future, particularly after 2015, in order to increase its export.

Howard Rogers (2012) also believes that Qatar might raise its LNG exports to the EU, if Australia expands its LNG supply toward the Far East and Qatar's LNG to the Atlantic basin will dramatically decrease.

Peimani (2011) believes, in the absence of the American gas market, Qatar could expand its LNG export capacity to Asia–Pacific and the EU's markets.

However, we could not ignore this point that global demand is expected to increase by 50% over the next 25 years, according to US EIA (2011: 43) and Qatar Petroleum (2007, issue 1: 1), while the US' self–sufficiency by unconventional gas will be under 18% by 2030 (Chapters 4&5).

Qatari officials, moreover, announced that any more LNG facilities will not be constructed in the future, and some others have insisted on this country's

[1] Gulf Cooperation Council (GCC) Created on 25th May 1981 and included 2,500,000 km^2. The Council comprises the Persian Gulf states of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates. Iran and Iraq are currently excluded, although both nations have a coastline on the Persian Gulf.

leadership in the global LNG supply as the key policy goal for the government in the future, according to the Qatari Ministry of Foreign Affairs (European Commission, Qatar Country File, 2011).

In summary, Bahgat (2010) expressed that, "there is no way to predict the outcome of this assessment over the amount of Qatari LNG export to the EU."

On the basis of official data analysis, Iran and Qatar could be the main natural gas and LNG producers since 2020 after Russia and the US. The US EIA in its International Energy Outlook (2011: 43) acknowledges that both Iran and Qatar can hold 20% of global gas production in the mid–term. According to this report, the Middle East/Persian Gulf will hold the most growth in gas production worldwide between 2008–2035, but face some challenges and competitors (see details in Chapter 4: unconventional gas as a rival for Persian Gulf's conventional gas).

1.2. Terminology of the energy security

Energy is "at the heart of economic development in every country" (Pascual & Elkind, 2010: 1) and "affects everything, and everything affects energy" (Sovacool & Lim, 2011: 416), so this term has always been "a matter of security" (McGowan, 2011: 490).

Since the Industrial Revolution, "the geo–politics of energy has been a driver of global security", and the challenge of energy security has been the topic of decades–long debate in the world (Pascual & Elkind, 2010: 6 & 9). On this basis, some predict that energy would be as a major concern for almost all countries worldwide during the 21st century (Bahgat, 2011: 1 & 2; Alhajji, 2007), while it has been a huge anxiety during the last 100 years and strongly affected globally by some events, such as the US oil embargo on Japan prior to the Second World War, the Arab and some non–Arab oil embargoes following the Yom–Kippur Arab–Israeli war in 1973, Iran's Islamic revolution in 1979, as the second major oil crisis and stronger than previous ones (Proedrou, 2012), the Iran–Iraq war in the 1980s, the Iraqi invasion of Kuwait and the subsequent Persian Gulf war in the 1990s, Russia's gas cut–off to Ukraine in 2006–2009, insurgencies in Iraq and Nigeria, as well as strikes in Venezuela (Luft, 2009: 43–56).

As a result, the main concept in the research hypothesis is the energy security. Barry Buzan et al. (1998: 105) argued that the energy policy has been more securitised, thereforethe excessive dependence on energy has boosted pressure on the energy security, or its synonym "the security of supply" (Alhajji, 2007). According to Felix Ciuta, energy security means the security of everything (2010: 136), for two major reasons: growing expansion of global energy needs, and environmental challenges because of the increasing consumption (Peimani, 2011: 1).

Energy can be considered in three aspects:

- ✓ The type of energy resource, like nuclear, renewable energy sources or hydrocarbons;
- ✓ The sectors of activity, e.g. extraction, transport or distribution (Ciuta, 2010: 132);
- ✓ The main actors, including producers, transit states, consumers, and international organizations (Luft & Korine, 2009: 8).

Nevertheless, the economic considerations and political issues are the two sides of the coin for the energy security; therefore it is necessary to explain the challenges that both provide (Proedrou, 2012).

Luft and Korine (2009: 335–350) have also separated the energy security realists' literature from idealists' literature over this concept, while the former insists on the below items.

- Energy security in line with the national interests;
- Uncertainty over the long–term energy supply;
- Political utilisation from strategic commodities, such as natural gas and oil;

- More interdependence for a more collective energy security;
- Probable energy war in the future.

The energy security idealists, however, like the EU's energy policy–makers, emphasise on:

- The power of the energy market, logic and its interconnections;
- The lower cost of negotiation compared to any conflict to access the hydrocarbons.

Notions of security of energy supply or in short–form energy security (Löschel et al. 2010: 1665–1671) sometimes differs by personal and institutional perspectives. It has been defined by different literatures with nearly 45 definitions of this concept (Sovacool & Lim, 2011: 3), raised by different global energy organizations, bodies and institutions, as well as some high–profile realist and idealist experts, that have some common indicators.

The IAEA (2007: iii) has insisted on a secure supply of energy, protection against disruptions and price volatility, encouragement of diversity of technologies and sources in order to create more self–sufficiency, competition within markets that distributes those fuels and also improvement of environmental sustainability.

The IEA, furthermore, explains the IAEA's energy security indicators, for instant more reliance on indigenous resources that are environmentally clean, reliable access or availability of resources (the IEA Model of Short–Term Energy Security, 2011: 9), while W.C. Ramsay, Deputy Executive Director of this international energy body emphasised on ensuring energy security by secure, reliable and affordable energy in addition to concerns over the environment (W.C. Ramsay, 2008).

The US Department of Energy also believes that energy security should be promoted through reliable, clean, and affordable energy, the same definition used by some energy security prominent experts, saying "the provision of reasonably priced, reliable, without any interruption and environmentally friendly energy" (Müller–Kraenner 2007: xi; Yergin 2006, Alhajji 2007a; C. Jansen & Seebregts, 2010: 1655).

The US Chamber of Commerce, in its study in 2010, has presented the four dimensions of energy security, comprising:

- Geo–political (energy imports, particularly from politically unstable regions);
- Economic (high energy intensity and trade imbalances);
- Reliability (adequacy and reliability of infrastructure);
- Environmental (related to the carbon intensity of the energy system and greenhouse gases).

The European Commission has concentrated more on the energy security since the 2000 Green Paper on "Security of Energy Supply" and defined this term: "Energy supply security must be geared to ensuring…the proper functioning of the economy, the uninterrupted physical availability…at a price which is affordable…while respecting environmental concerns… security of supply must seek to reduce the risks of energy dependence" (European Commission, 2000: 2). These characteristics are just the same as a definition raised by Cambridge Energy Research Associates (CERA, 2006: 22), Barton and his colleagues (Barton et al. 2004: 5), as well as the World Energy Assessment that all argue on the constant availability of energy flow for the foreseeable future in various forms and in sufficient quantities at affordable and reasonable prices.

The United Nations Development Programme (UNDP) in 2001, has also repeated these energy security indicators but emphasises the importance of the availability of sufficient different energy sources. Peimani (2011: 2) has urged these features, too.

According to Anas F. Alhajji, the energy security includes six dimensions, these being economic, environmental, social, foreign policy, technical and security (Alhajji, 2007c), while Cherp and Jessica (2011: 202–212) believe that the geo–

political aspect of the energy security is the key theme of energy insecurity during the 21st century and also Wicks, the current UK Prime Minister's energy representative and ex–Energy Secretary has argued, (Wicks, 2009: 1) that the technical and economic dimensions are more important than the other aspects.

So, the brief elaboration on these dimensions is followed by this definition of energy security, which encompasses the above six dimensions: "The steady availability of energy supplies in a way that ensures economic growth in both producing and consuming countries with the lowest social cost and the lowest price volatility" (Alhajji, 2007d).

Cherp and Jewell (2011: 209) have also indicated to the three energy security dimensions, comprising "sovereignty, resilience, and robustness". They have suggested that the sovereignty perspective on energy security concentrates on the threats posed by the external actors, such as embargoes, acts of sabotage or terrorism, so the ability to switch to more dependable suppliers or diversifying of energy sources could lead to a reduction in the effects of these threats (Cherp &Jewell, 2011: 207). The "resilience" viewpoint insists on capability to respond to diverse disruptions and threats by more infrastructure, flexibility and adaptability (Cherp & Jewell, 2011: 208), and the "robustness" perception urges adequacy and reliability of resources and infrastructure.

According to the World Energy Council, energy security means "reduced vulnerability to short–term or long–term physical disruptions to import supplies, as well as the availability of local and imported resources to meet the growing demand for energy over a period of time and at affordable prices".

K. Sovacool and Wei Lim (2011: 424), have argued that the energy security is not only physical but psychological, so "the perception of any possible interruptions in supply, even the supply and demand of energy remain unchanged, can result in the feeling of insecurity".

On the basis of the importers' perspective, energy security means security of supply without any energy shortage at reasonable and even competitive prices without further deterioration the state of the environment (Proedrou, 2012). For exporters, on the other hand, “energy security equates with security of demand at competitive prices that will guarantee significant profits for the exporter with no excessive cost to the environment”, so economic downturn in importing states leads to reducing energy demand and the exporters do not support recession or switching to alternative sources (Proedrou, 2012).

Luft and Korine (2009: 9), as well as Pascual and Elkind (2010: 4) argue that the importers support security in energy supply adequately with lower and affordable prices and exporters are keen on long–term guarantee demands by importers with fair pricing and development of new fields with advanced technology and enormous investment. As a result, both of them support a diversification policy of supply and markets (Luft & Korine, 2009: 361), whereas, the transit countries by attracting investments attempt to strengthen their energy security as well (Luft & Korine, 2009: 335–350).

This concept has also concentrated on global, regional, states, organizations and companies, as well as individual levels.

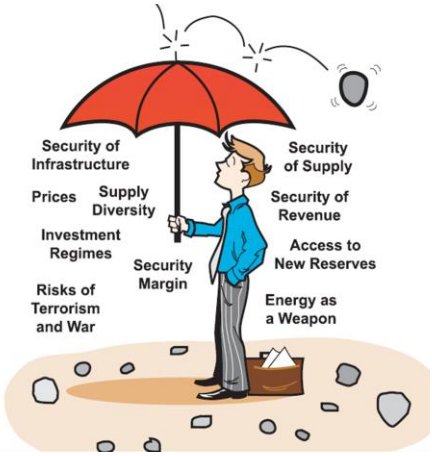
Level and time frame, moreover, are two additional aspects of energy security. It is influential in three scales: the household, the nation–state, and the global context (Pachauri, 2011: 191–205). Gal Luft and his colleagues (2011: 43–56) and also Peimani (2011: 2) add regional scale to these three, which is affected by political, economic, military/security, social, and environmental factors. So, at the state level concentration is on bilateral energy relations between two states, whereas in the regional level, the focus is on dependencies or interdependencies within the region and inter–regional relations. While electricity, heating and transportation prioritise in energy security concept (Luft & Korine, 2009: 6), at household and nation–states or micro and meso levels (K. Sovacool, 2011: 2), long, medium and short–terms policies against any challenges seem vital (D'Agostino, 2011: 205–218).

Gal Luft, Anne Korin, and Eshita Gupta (2011: 43–56) attempt to identify many of the threats to regional and global energy security as the macro level (K.

Sovacool, 2011), such as geo–political struggles over resources, environmental pollution, and climate change.

The energy security, however, is threatened by some dangers, such as the increase in energy prices, and growing global competition for energy resources with the emergence of huge economies, like China and India (Wicks, 2009: 3). Pascual and Elkind argue (2010) that the geo–political dimensions of energy security account for energy–related relationship between exporters and importers. However, the new aspect of that takes shape between various consumers competing over more energy supply.

Figure 3: The umbrella of the energy security



Source: World Energy Forum, 2006:8

Growing population and rising standards of living could push global energy demand up by 40% by 2030, and this will lead to pushing up global prices (European Commission, 7th Sepember 2011: 2).

Regarding time frame, Jansen specified five different time dimensions of energy security challenges, comprising:

- Near real time, or less than 1 minute;
- Short term, or less than 2 years;
- Medium run, or 2 to 15 years;
- Long run, or greater than 15 years;
- Very long term, or greater than 50 years (Jansen & Van der Welle, 2011: 239–250).

Short–term physical disruptions of energy supply occur due to temporary and non–predictable events, such as political events, technical failure, extreme natural or climate accidents, and terrorist attacks, hence it needs to react promptly to sudden changes in supply and demand (Fattouh, 2007: 7).

More transparency in the global gas markets and energy prospects (W.C. Ramsay, 2008) on the basis of international organizations' cooperation, such as the IEA (Yergin, 2006: 69–82), as well as more attention to intensify security levels, such as maritime, against any threats are the most important solutions to combat this short–term challenge to improve the energy security (Jansen & Van der Welle, 2011: 239–250). Consequently, in all these respects, the short, medium and long terms perspectives of energy security are essential (Gheorghe & Muresan, 2011: 2).

The medium and long–term physical disruptions of energy supplies are more related to structural dimension of energy security and as a result of the prolonged political problems, environmental and lack of adequate investment (Gheorghe & Muresan, 2011: 2). So, diversifying of energy resources and suppliers alongside more energy efficiency, more research and innovation, as well as development of high–tech (Yergin, 2006; W.C. Ramsay, 2008), sufficient investment in energy industries and infrastructures both in consumers and producers (Eurogas, 2010: 6) are amongst the measurements that could fight the medium and longer–term energy security challenges.

In addition, Daniel Yergin (2006) has referred to the "security margin", as the buffer against shocks and interruptions, such as sufficient spare production capacity, strategic reserves, adequate storage capacity, etc.

Energy interdependency and collaboration amongst the consumers and also between consumers and producers bilaterally or within multilateral frameworks (Yergin, 2006), as the "cooperative energy security" (Cutler, 1999), leads to economic development and world peace (Bahgat, 2011: 2).

Contrary to President Nixon's remark that first called for energy independence (Pascual & Elkind, 2010: 212), in an era of intensifying of international and transnational interactions, any move toward a fully energy independence would most possibly weaken rather than enhance notions of security and could even lead to greater costs, as well as an isolationist energy policy (Proedrou, 2012). Moreover, participation in the global market is beneficial and functions as a shield against supply shortages and energy independence is neither feasible for most countries nor realistic and achievable goal in itself (Pascual & Zambetakis, 2010: 31 & 152).

Failure to ensure energy security could cause an energy crisis. From the exporters' view an energy crisis takes place when the exporter is unable to sell its energy at affordable prices and that can lead to a fall in investment and profits. Hence, an energy crisis erupts when energy resources are scarce (unavailable), when producers are unreliable (inaccessible) or when the prices rise to an unsustainable level (unaffordable) (Proedrou, 2012).

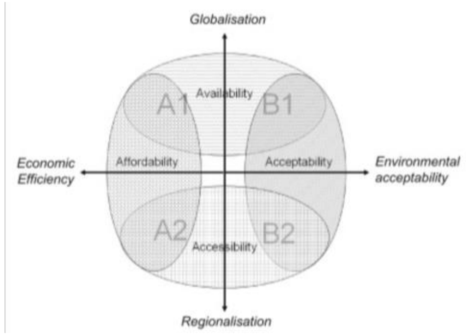
Hisham Khatib, Honorary Vice Chairman of the World Energy Council believes that, "We always try to define energy security as being the continuous availability of energy in the right forms, in sufficient quantities and at reasonable prices, although the only forms of energy available now, and in the future, are fossil fuels, based on the major indicators" (Khatib, 2005: 14; World Energy Council, 2008).

As a consequence of examining the above–mentioned definitions of the energy security by organizations, institutes, think–tanks, and energy specialists, four common main indicators could be observed. Bahgat (interview, 2012) argued that the main international energy organizations, such as the IEA, believe that the energy security has four major standard indicators, comprising acceptability, availability, affordability, and accessibility (figure 4). The Institute for Energy Security Unit of the Joint Research Centre (JRC) for the European Commission (2010: 4), the APERC (Asia Pacific Energy Research Centre) and many of energy experts' conceptualisations, like Jessica Jewell in "the IEA Model of Short–term Energy Security", have taken into account these four indicators, despite some restrictions.

Peimani has employed sustainability as synonymous with acceptability and Global Energy Assessment (GEA 2012: 22) and Sovacool (2011: 337) applied the term of feasibility, equivalent to accessibility. Furthermore, the latter energy expert has used reliability in place of accessibility (K. Sovacool, 2011: 9).

Therefore, "the new vision of energy security", based on this classification scheme (Elkind, 2010: 144) is the cornerstone of this research for testing them on the EU's LNG relations with different actual and potential suppliers, such as the Persian Gulf and then comparing them for ranking to establish the most suitable suppliers in the future:

Figure 4: The indicators of the global energy security



Source: Energy Policy 37 (2009): 2168

- Acceptability, or environmental and social elements;
- Availability or geological elements;
- Affordability or economic elements;
- Accessibility or geo–political elements.

The energy security had, moreover, traditionally focused on crude oil supply disruptions by the end of the Cold War (Fattouh, 2007: 23; Cherp & Jewell, 2011: 203), but with the expansion of the EU, the break–up of the USSR and the economic explosion in the Asia–Pacific region, some core shifts in energy demand and supply have taken place. Consequently, since the 1990s, natural gas became more the "fuel of choice" ("The New Energy Security Paradigm", 2006: 11) with an increase of its use in recent years and also in the future, in particular within the EU. Hence, this tendency increases concerns relating to security of gas supply (Kruyt et al. 2009: 2167). So, energy players' definitions regarding the energy security depend on their energy situation and their views over their vulnerabilities to energy disruptions. For Americans, for instance, energy security is more about oil and transportation. However, for the EU members, energy security is much more dependent on natural gas (Luft & Korine, 2009: 11; Pascual & Zambetakis, 2010: 9) so, “Gas is the new oil”.

High oil prices since the mid–2000s, the discovery of a number of new gas fields in previous years, the least–carbon intensity of natural gas, technological off–shore and on–shore innovations, as well as unconventional gas (Proedrou, 2012), political instability within the oil markets, the function of cartels, such as OPEC, a rather unclear picture for oil trade in the mid–term (Cable, 2010: 75–82) have resulted in the importance of natural gas and LNG increasing in recent years and this is expected to continue in the future (Proedrou, 2012).

Aleh Cherp and Jessica Jewell, conversely, said there some limitations in the ability of the existing energy security indicators to measure it (Cherp & Jewell, 2011: 330–356), and also Bert Kruyt and his colleagues believed that there is no single ideal indicator for energy security (Kyuyt et al. 2011: 291–313).

I will try to quantify these indicators (Hafeznia, 2010: 47–49) and operationalise the energy security, as the main concept in my hypothesis (Creswell, 2003: 220), while some of them remain qualified (see details in Chapter 1&5: The terminology of the energy security and its main indicators), and then test these mostly quantified indicators (Frankfort & Nachmias, 2008: 403–408) on the LNG relationships between the various actual and potential suppliers and the EU for hypothesis testing (Burnham et al, 2008: 42; see details in Chapters 5 and 6).

1.3. Theoretical Frameworks

It is necessary to select three appropriate theoretical frameworks for this research and I will try to discuss an appropriate theoretical framework for the EU firstly, followed by another suitable theory for the Persian Gulf and, in the third stage, I should connect these two theoretical frameworks by one more theory that should be related to security issues, as the concept of the energy security is the main connecting factor between the Persian Gulf and the EU in my hypothesis. As a result, at the conceptual and theoretical level, I adopt the Regional Security Complex Theory (RSCT) on energy security to connect the "New Regionalism" theory for you the EU and the "Subordinate System" theory for the Persian Gulf. Then, I should extract the main indicators of the energy security and will test on various actual and potential LNG suppliers' relationships with the EU to test my research hypothesis and answer the question(s).

The EU, comprises 27 independent countries, united under one European institutional structure, while maintaining national sovereignty. This Union, as a "Marco–Region" (Farrell et al. 2005: 87–95) or "core region" (Fawcett & Hurrell, 2004) and one subsystem between the state and the global levels (Farrell et al. 2005: 24) is the most integrated region worldwide (Fawcett & Hurrell, 2004) and might develop further in the future when some other countries of the European continent join this Union.

A region is a geographical structure with a set of states with common feature(s), at least geographically and strategically. Of course, economic, cultural, political, and security are sometimes the pillars of the region without geographical proximity, such as Arab Union (Mojtahed Zadeh, 2010: 230–231).

According to Buzan and Weaver (2003), regionalisation constitutes a level of analysis of international relations situated between the local and the global.

Regional co–operations and institutionalisation have been part of the process of decentralisation in the international system (Mojtahed Zadeh, 2002: 247) and also one response to the competitive economic pressures associated with globalisation (Beeson, 2006: 544).

Regionalism was regarded as a multidimensional integration ranging from economic, cultural, political, social characteristics to security aspects with states, non–state actors, organizations, institutions and social groupings, as the main actors (Farrell et al. 2005: 8), refer to "new regionalism", particularly after 1990 (Karoline, 2007: 564–565) and the "post border" age (Dear & Lucero, 2005: 317–321) in a multipolar world order and differing from the old regionalism of the

1960s. The latter, was basically formed in a bipolar Cold War context, based on governments and relations between nation states, and demarcated the regions in terms of boundaries for growth, job markets and the like.

The Energy Policy in the EU has been adopted regionally and concentrates on forming a competitive internal energy market or the "Pan–European energy market" (Sascha Muller–Kraenner, 2007: 33) with high quality service at low prices, developing renewable energy sources, declining dependence on imported fossil fuels, decreasing of consumption of both hydrocarbon and non–hydrocarbon energies and also more energy efficiency. After the adoption of legally binding energy targets to address climate change, energy security and competitiveness, the 27–member states are now emphasising on the implementation of these targets. As a result, energy decision–making within the Union is more regionally, rather than nationally. For this reason, new regionalism seems to be the most appropriate theory to analyse the EU's energy security in the future.

So, the indicators of the European integration are based on "new regionalism" theory, as the most appropriate theoretical framework for the EU in this research.

Fawcett and Hurrell (2004: 312–313), counted two more kinds of regions, comprising the "intermediate regions", being closely linked to the core regions, as well as "the peripheral regions" within the international system. The latest are politically turbulent, such as the Persian Gulf region and also economically stagnant. So, the regional arrangements are fragile and make the security issues much more of a priority.

The Persian Gulf, as the "micro–region" (Farrell et al. 2005: 87–95), the "regional grouping" (Mojtahed Zadeh, 2010: 240; Karoline, 2007: 558) or "unstructured region" due to its insufficient security interdependence (Buzan & Waever, 2003: 492) exists between the national and the local level (Farrell et al. 2005) and includes some quite independent states with a degree of economic and geo–politics commonalities (Mojtahed Zadeh, 2010).

This region consists of the GCC, Iraq, as non–GCC Arab country and non–Arab Iran, as well as some ultra–regional players, such as the US, France, etc.

Louis Cantori, and Steven Lospiegel in their co–authored book, entitled "The International Relations of Regions", published in 1970 and also an essay, entitled "International Regions: A Comparative Approach to Five Subordinate Systems", released in International Studies Quarterly, Volume 13, No: 4, in December 1969, theorised the "Subordinate Systems".

They argued that the subordinate system, as a regional subsystem (Cantori & Spiegel, 1970: 5) in international relations (Cantori & Spiegel, 1970: 378), consists of the core or center sector, the peripheral section and the intrusive player(s). This system consists of a number of adjacent and interacting states which have some common ethnic, linguistic, cultural, social, religious, and historical bonds, or at least have geographical proximity. However, the diplomatic orientation of some of these states is sometimes toward the ultra–regional player(s).

They added that the states within the core sector of a region or subordinate system have shared social, political, economic, religious or organizational backgrounds and also there can be even more than one core section within a given subordinate system. The peripheral sector includes all those states which are separated from the core sector to some degree by economic, organizational, social, religious or political factors, but play a role in the politics of the subordinate system. In addition, relations between the core and periphery are often more important than between the periphery countries, while the relations with the international system take precedence over relations with such a subsystem (Cantori & Spiegel, 1969: 375).

The periphery members, especially those which are isolated, often attempt to manipulate the security objectives of the intruding powers (Cantori & Spiegel, 1970: 171) and, occasionally, the peripheral actors interact to a higher degree than in other peripheries, likely to be united, at least in part, by a common intrusive power (Cantori & Spiegel, 1970: 171).

The intrusive or penetrating (Cantori & Spiegel, 1970: 297) part consists of the external power(s) participating in the region politically, militarily and also in and organizational cohesion process (Cantori & Spiegel, 1970: 293).

The power of intervention, moreover, has politically significant involvement and participation in the balance of power of a subordinate system through possession of a colony, the transfer of economic or military aid, formal alliance, and troop commitment. Therefore, this external power impacts on policies of both core and periphery players, as well as the regional affairs.

In the Persian Gulf region, as the subordinate system of the Middle East, the GCC is considered as the core section, due to the common political, economic and social features amongst the states, despite other differences.

Iran and Iraq are the peripheral players, as they have some significant disagreements with GCC, but the former states, particularly Iran, have the power to exert influence on the regional policies.

Finally, the US, during the recent decades, has been the main power of intervention in the Persian Gulf area, while some other ultra–regional states have participated in regional order and policies, such as France.

In the third stage of this theoretical framework, the researcher attempts to investigate the relationship between the Persian Gulf's subordinate system and the EU's new regionalism theories, as in the research hypothesis stated in the case of the above–mentioned regions linked to each other by the energy security. So, it seems that the regional security approach (Buzan & Waever 2003: 27) is located between the global and state levels and would be a proper theory in this respect.

Regional Security Complexes Theory (RSCT) is a theory of regional security that Barry Buzan and Ole Waever developed in their co–authored book, entitled "Regions and Powers: The Structure of International Security" in 2003. In essence, this book systematised the authors' earlier analysis of Regional Security Complex (RSC), in the previous works, entitled "People, States & Fear" and the

"Security: A New Framework for Analysis" published in 1991 and 1998, respectively into the RSCT. Indeed, they argued in the 1991 work that in geographically shaped regions, how security is explained by the concept of regional security complex. However, Classical Security Complex Theory, one stage before the RSC (Buzan, 1998: 15), was raised by Buzan in the first edition of People, States and Fear in 1983 (pp. 105–115).

So, the regional security complex, as a distinct level of analysis located between global and state levels (Buzan & Waever, 2003: 27), can be seen as a group of security dilemmas concentrated into certain geographical areas (Buzan & Waever, 2003: 4) where essential threat perceptions by states and non–states caused to create a kind of security interdependence, so that the security of one state cannot be easily separated from the security of another (Buzan & Waever, 2003: 44).

According to Buzan, Waever and de Wilde, the sectors of security in the Regional Security Complex Theory are military, political, economic, societal and environmental security.

Buzan and his colleagues (1991: 215–220) described four main concepts as the structure of the security complex that could be conveyed to the Regional Security Complex (Buzan et al. 1998: 13), including:

1) Maintenance of the status quo, that structure of the security complex does not need to change as a result of some developments;

2) Internal transformation, that structure of the security complex changes within the existing boundaries of the complex as a result of some developments;

3) External transformation, that outer boundary of the security complex is changed, because new states move into the complex or states move away from the complex;

4) Overlay, which in military security means overwhelming military presence by the more powerful state in the area of weaker state(s) that suppress functioning of normal security dynamics of the region.

As the researcher has mentioned previously and also will indicate in Chapter 5, the recent and the current literature review employs energy as a matter of security and Barry Buzan alongside his colleagues (Buzan et al. 1998: 105) believe that the energy policy has been securitised. So, “the heavy reliance on energy with the rise of a combination of geo–political, geological, economic, and environmental challenges alongside the sporadic global distribution of energy deposits, has increased pressure on the energy security”, or its synonym the security of supply (Alhajji, 2007). In his 2007 work “Energy Security and the Regional Security Complex Theory,” Mikko Palonkorpi endeavored to develop the indicators and definitions of the mentioned theory to energy issues. While Buzan alongside his colleagues (Buzan et al. 1998: 105) believe that the energy policy has been securitised, as a result, the Regional Security Complex Theory could be applied to the energy, as the sixth security sector with already established military, political, economic, societal and environmental security sectors.

Therefore, the mentioned notions could change under various circumstances and the structure of the energy security complex within the EU, considering natural gas and LNG as the fieldwork of this research, could be matched to the four mentioned parameters. On this basis:

- ✓ Status quo, that the EU supports the existing natural gas and LNG in the region, therefore the current plans for LNG constructions seems sufficient and also growing dependency on Russian gas will not influence this position;
- ✓ Internal transformation would occur when regional energy projects within the EU, like LNG liquefaction facilities, show the Union’s trend regarding the change of the present situations, such as gas dependency on special suppliers;
- ✓ External transformation can take place as a result of new natural gas and LNG routes bringing substantial amount of additional energy resources to the complex from ultra–regional suppliers and leads to change the energy dependency patterns and link new states to the complex;

- ✓ Overlay in the energy security complex could be viewed as almost total dependency on one gas supplier, hence this state turns to a monopoly in gas supply.

On the basis of the current EU's energy policy, this region decides to increase its natural gas and LNG imports in the future and the number of existing LNG facilities, together with those under construction and under consideration confirms this point, while the Union becomes dissatisfied with huge dependency on Russian gas during the later years and diversification of natural gas and LNG suppliers is amongst the vital EU energy trinity (Internal transformation) (see details in Chapter 2).

In addition, some LNG projects are in progress in gas suppliers and the EU will be one of the most important destinations of these actual and potential exporters in the future (External transformation).

As a result, the EU is not interested in supporting the status quo in its natural gas and LNG policies and also could not tolerate dependence on special gas suppliers (overlay).

The level of analysis of the energy security would be at least from state and regional levels, while in the state level, it concentrates on bilateral natural gas and LNG relations between two states, whereas in the regional level, the focus is on dependencies or interdependencies between two regions. In addition, natural gas is not a globalised commodity, but a regional one.

In summary, the Regional Energy Security Complexes are formed by energy interaction between two or more states or regions in a limited geographical area with different players, comprising exporter(s), importer(s) and transit state(s).

Chapter 2: The EU energy matters

2.1. Introduction

Energy has been a shared issue among the European countries during recent decades and the energy security is a primary objective of the EU's foreign and policy, leading to grand EU's energy policy approval by its "energy trinity", comprising emergence of the competitive internal market, environmental/climate change, and security of supply together to prepare the Union for the 21st century energy challenges as well as, "Europeanisation" of energy by increasing of the renewable energy sources share in the energy mix.

It is important to indicate that the energy policy in the EU has approved regionally and any single voice in energy decision–making should not be strong in the future. Therefore, new regionalism seems to be a proper theory to analyse the EU's energy security in the future.

The European Commission, however, foresaw a greater reliance on imports in the future, to around 80% of natural gas needs in 2030, according to BP 2012, so some believe that the energy security within the EU means "security of gas supply" and the shortest way aims to ensure security of supply is primarily diversification of gas suppliers, consequently natural gas will be the "Achilles heel of the EU's energy security", while the role of LNG in the Union rises.

The EU's energy security has been influenced by both internal and external factors. Internally, steadily rising energy prices, declining European energy production and a fragmented internal energy market have contributed to anxieties over Europe's ability to meet future energy demand. The strain on global demand exerted by the emerging economies of countries such as China and India, political instability in energy–producing regions and some transit states, the threat of terrorist strikes against energy infrastructure, any possible disruption of gas supply by natural or political reasons, and Russia's apparent willingness to use its energy power as a political leverage, are all raising concerns in the EU. According to BP, June 2011, by the end of 2010, the EU held 1.3% of global natural gas reserves. Natural gas is projected to be the fastest growing fossil fuel globally by 2030, with production growing in every region except Europe. The EU's gas production in 2010 was the equivalent of 5.5% global gas production and this figure alongside non–EU Norway reached 8.8%, according to BP Statistical Review of World Energy in June 2011.

According to EIA outlook published in 2011, the largest decreases in regional reserves throughout the world take place in the EU. The Union will be the world's largest gas importer by 2030, raising the gas import dependency of the region from 64% in 2009 to over 80% by 2020.

The Union receives more than 30% of its gas from Norway and partially from the UK, the Netherlands and other EU member states, as well as 34% from Russia. The rest of EU imports, 35%, come from Algeria, Qatar, Libya, Egypt, Nigeria and other exporters. There are 31 LNG terminals in the EU, either existing, under construction or under consideration, with the exception of cancelled and suspended ones, 24 of which, close to 80% of the Union facilities, are situated in the UK, France, Spain and Italy. So, these four EU member states imported nearly 80 bcm/y LNG, 15% of gas needs in 2010, and it is expected that this will increase to 24% by 2020, to 157 bcm/y out of nearly 670 bcm/y of annual gas needs. So, some main energy organizations predict that the share of LNG in total imports will expand to more than 40% by 2030 within the EU. As a result, in 2020, EU's LNG needs will rise 60% compared to 2010. Consequently, a high number of new LNG import terminals have been proposed in recent years in response to the increase in LNG demand in the EU. Some of these are already under construction and nearly 70% of new facilities would be in the four EU countries mentioned previously. Based on the future of natural gas imports within the EU, both pipeline and LNG, this will depend on some factors, particularly the effectiveness of the 20/20/20 targets by 2020 and the objectives of the EU's energy policy.

Accordingly, it suggests a range of gas demands in the EU, from 600–750 bcm/y by 2020 and 620–800 bcm/y by 2030, according to the scenarios mentioned below. By adding an estimated indigenous EU production, alongside Norway, of some 180–220 bcm/y in 2020 and 148–150 bcm/y by 2030, these supplies from non–

European suppliers will be in the range of 420–530 bcm/y until the end of the current decade and nearly 480–650 by 2030.

Therefore, the EU will require 120–160 bcm/y LNG by 2020 and 220–300 bcm/y until 2030, whereas the amount of importing LNG in 2010 was approximately 80 bcm.

In addition, if some pipeline projects do not materialise, the amount of LNG imported should be increased by end of the existing decade.

As mentioned above, it is possible to considered two different scenarios, including:

- ✓ Scenario 1: High growth in natural gas and LNG demand or base case demand;
- ✓ Scenario 2: Low growth in natural gas and LNG demand.

Pipelines are expected to remain the most dominant means of gas transport in Europe by 2020, however Europe's natural gas imports by pipelines will face some challenges, such as transit risk, Russian domination over most of the Caspian region natural gas reserves, delay in constructing new gas pipelines due to the geo–political issues and technical constraints and complexity of negotiations with different producer and transit countries, so diversification of natural gas import supply by LNG would be critical to ease these various supply risks.

Global LNG trade is expected to grow faster than gas trades by pipeline, growing from 296 bcm in 2010 to 540–566 bcm in 2020. In 2010 almost 15% of the EU gas imports were delivered by LNG from non–EU countries, compared to 13% in 2008.

Moreover, a number of the Union member states are constructing new LNG terminals for their needs and also to transport the extra inside the region. On this basis, LNG import outlook in the EU will rise to 24% by 2020, a 60%

increase compared to 2010, and also 40% by 2030; however continental gas production will decline from 51% in 2010 to 33% by the end of the current decade.

It is important to emphasise that the EU's effective fulfilment of its energy efficiency and renewable energy sources policies, as well as the number of commissioned pipeline projects in the future, will be the main two factors that will determine how much LNG should be supplied to the EU in the future.

Now, some questions are raised in this chapter and the analytical replies will be examined at the end:

- What is the position of natural gas and LNG in the EU's energy policy and its energy mix, past, present and the future?
- What is the position of natural gas and LNG in the energy mix of the UK, France, Spain and Italy past, present and the future, as well as which policies do they follow?
- Which role do these four countries play in the EU, as the main LNG entrances, past, present and the future?

2.2. European Energy Background

Energy was a cornerstone of European integration by establishment of the European Coal Organization (ECO) in 1946 and then the Organization of the European Economic Cooperation (OEEC) in 1948 (Morata & Solorio Sandoval 2012: 1), followed by the two treaties with a special focus and common approach regarding energy cooperation in coal and steel, the so–called the European Coal and Steel Community (ECSC) in 1952, as well as the European Atomic Energy Community (Euratom) in 1957 (European Commission 10th January 2007: 3; R. Odell, 2002: 502) that represents some of the European Economic Community (EEC) energy challenges in the era (Eurostat Statistical Book, ISSN 1831–3256, 2009: 4).

However, the Arab oil embargo in 1973 threatened the global and also the European energy security, as "the EU's energy security could not be separated from global energy security" (Bahgat, 2010: 333–347). This led to the institution of the IEA in 1974 in order to adopt the new measurements and effective energy policy to ensure the energy security in importers (McGowan, 2011: 487).

The European Commission also placed energy and energy security at the top of the Community's political agenda because of the 1970s oil crises (Morata & Solorio Sandoval 2012: 11). This was intensified more than three decades later by the 2006–9 gas crises (McGowan, 2011: 488), as a key issue not only on the EU's policy agenda during the first decade of the 21st century (Council of the EU, 11th December 2008), but also a global issue in years to come (BP 2012, Energy Outlook 2030: 82). So, the energy security is a primary objective of the EU's foreign and security policy, according to Inge Bernaerts' interview on 2nd April 2012 (annex 1).

Fifty years after the Treaties of Rome, the evolution of energy issues in Europe, such as increasing move to gas–fired power plants, somewhat remarkable after the Union's decision regarding more use of natural gas in power generation in 1992 (Kandiyoti, 2008: 38), and also the importance of the renewable energy sources in energy mix, necessitates new energy policies and regulations (Eurostat Statistical Book, ISSN 1831–3256, 2009: 4) with aims to more extensive use of renewable energy sources and narrow use of fossil fuels (Proedrou, 2012: 1).

Since the middle of the 1990s, the EU broadened its energy activities by the Energy Charter Declaration and the Commission's White Paper in 1995, highlighted some regional energy concerns, such as dependence on any special supplier (the European Commission's White Paper, 1995: 21).

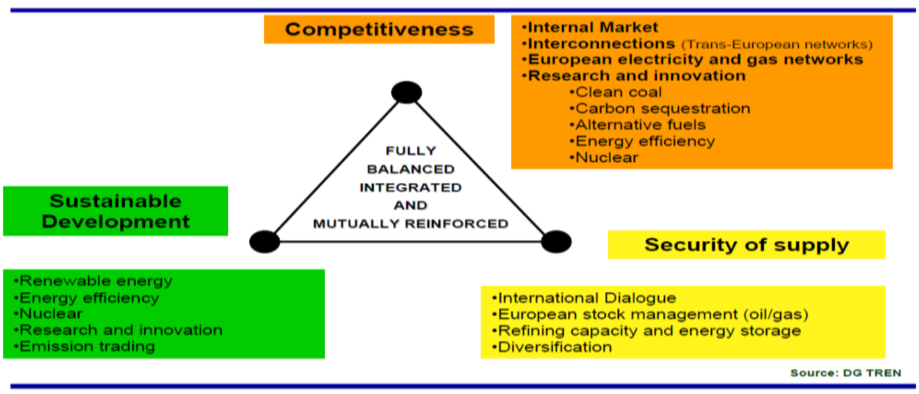
In December 1994, the European Energy Charter, a basic treaty for a common pan–European energy policy (CRS Report; RL33636: 4) and an initiative for promoting of energy cooperation and security by incorporating at least one major supplier, Russia, in addition to diversifying of exporters, was signed (Florini, 2010: 165), however this declaration entered into legal force in 1998 (www.encharter.org).

2.3. The EU's Energy Policy

The European Commission in its Green Paper, entitled "Towards a European Strategy for the Security of Energy Supply", warned (2001: 3), that "without an active energy policy, the EU will not be able to free itself from its increasing energy dependence alongside the urgent need to diversify the various sources of supply geographically". As "the energy is fundamental to the daily lives of every European" (EU Green Paper 8th March 2006: 4), the EU's Heads of State and Government in their summits in October and December 2005, put the energy security on the EU's political agenda and asked the Commission to concentrate on internal markets, environmental/climate change, and security of supply together (Morata & Solorio Sandoval, 2012: 3).

These led to the Green Paper adoption on 8th March 2006, entitled "A European Strategy for Sustainable, Competitive and Secure Energy" (figure 5), while the sides of this "energy trinity" for the "forward–looking EU's energy policy" (Davidson, 2012: 2), have looked to the indigenous energy supply, internal energy market and external energy relations (Belkin, 2008: 26) to prepare the Union to face the 21st century energy challenges (Morata & Solorio Sandoval, 2012: 2).

Figure 5: The EU's energy policy targets



Source: Lefèvre Thierry & Lefèvre, Francois (2009), "Energy Security: The European Approach and the ASEM Ministerial Conference Perspectives", Energy Security in SEA and beyond-from Competition to Cooperation? Conference, Singapore, 20-22nd October: 17

The Council of Europe (2007: 11) explained the EU's energy policy goals, comprising:

- ✓ More strength of the security of supply;
- ✓ Ensuring the competitiveness of European economies and the availability of affordable energy price;
- ✓ Promoting environmental sustainability and combating climate change.

The European Commission also insisted that the European people and industry rely on safe, secure, sustainable and affordable energy (European Commission, 2011a: 2).

The EU's energy policy objectives are similar to the international energy policy, such as IEA's energy policy indicators, entitled "The Shared Goals" passed by IEA Ministers on 4th June 1993 in Paris, which aimed to ensure more short, medium and long–term energy security, comprising diversity and efficiency within the energy sector, more environmentally acceptable energy sources, competitive and open energy markets (Energy Policies of IEA Countries, France 2009: 158)

The European Commission (2006a: 4) also states that these three objectives are "the pillars of ... [the EU's] daily life", and are all interrelated and deal with both the short– and medium–term targets and a longer–term strategy, such as roadmaps for 2050 (Buchan, 2011: 32) with the aim of guaranteeing the Union's energy security (McGowan, 2011: 505).

R. Odell argues in his book that the competitiveness and security of supply have some records in Europe, dating back to 1950s and 1960s, showing that the continental energy markets were open to competition between coal and rapid growth in oil demand (R. Odell, 2002: 477).

Sustainable energy, furthermore, includes the lasting and reliable access to primary energy sources that needs to have adequate infrastructures to produce and deliver the required amount of environmental–friendly energy satisfactorily to the consumers (J. Pérez–Arriaga, 2007: 3).

The security of supply, moreover, as the “Gulliver in chains”, according to the European Commission’s Green Paper in 2001, entitled “Towards a European Strategy for the Security of Energy Supply” (2001: 22) could be achieved through full market integration or a Pan–European gas market from nationally to regionally–based, according to Hans Haider, Austrian Honorary President for Eurelectric (2005: 109) or the “EU’s Grid” (J. Pérez–Arriaga, 2007: 13) and also by liberalisation, as well as competition (McGowa, 2011: 494), whereas “the road to competition is longer and more complex than was anticipated” (Chevalier J.M, 2006: 5), while any improvements in energy efficiency and increase in renewable energy sources consumption have effects security of supply by decreasing energy demands (Taylor et al. 2005: 360).

In other words, the new energy paradigm and policy insists on securing supply, sufficient energy infrastructures, cooperation among the importers and exporters in order to secure a more globalised gas market, environmentally sustainable policy, as well as energy efficiency initiatives that the EU has observed and adopted in its energy policy (Proedrou, 2002: 17–20).

The Lisbon Treaty on Functioning of the EU (TFEU) provides a legal basis for the EU’s energy policy aimed at securing energy supplies in Art. 194, 1, TFEU9, which argues as follows:

- ✓ Ensure the functioning of the energy market;
- ✓ Ensure the security of supply in the EU;
- ✓ Promote energy efficiency and energy saving, as well as development of the new renewable energy sources; and
- ✓ Promote the interconnection of energy networks.

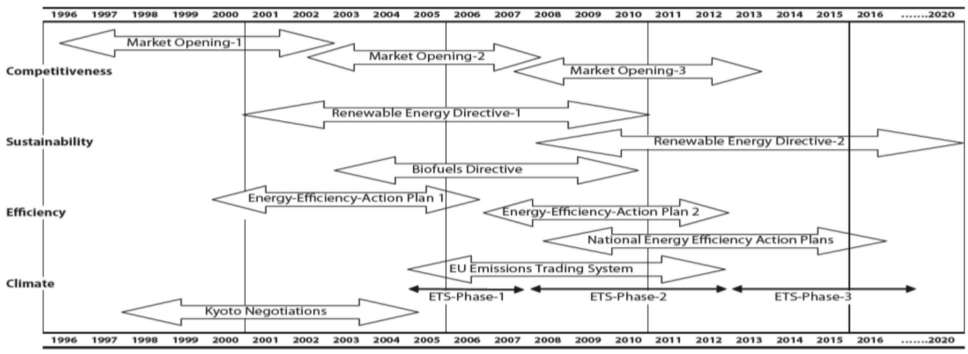
Consequently, the aspects of the energy security, including the security of supply (availability and accessibility), economic efficiency (affordability) and protection of the environment (acceptability) (Proedrou, 2002: 11) have been laid down in the EU's energy policy to ensure "the uninterrupted physical availability of energy products and services on the market, at a price which is affordable for all consumers, while contributing to the EU's wider social and climate goals" (EU's Energy Strategy for 2020, 10th November 2010: 2).

2.4. The EU's energy mix

The EU open market is now entering its third phase, while the second Energy Efficiency Action Plan is underway and renewable energy sources energy legislation is entering its second

phase (figure 6), on the basis of the renewable energy sources Directive, as part of the major energy and climate package, unveiled by the European Commission in early 2008 (Eurostat Statistical Book, ISSN 1831–3256, 2009: 3).

Figure 6: Development of EU's Competitiveness and Sustainability Eenergy Policy over time



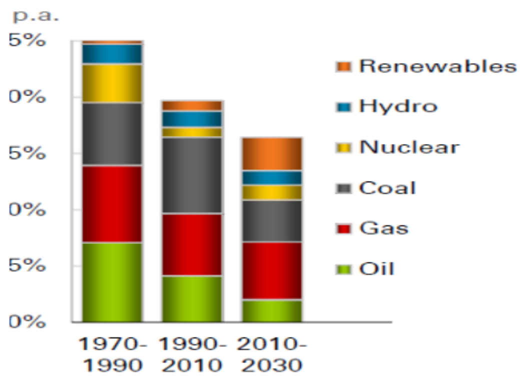
Source: Eurostat Statistical Book, ISSN 1831-3256, 2009: 3

The EU has tried to shift gradually to a low–carbon society, particularly by renewable energy sources since 1997 (European Commission, 10th January 2007: 13), and then by ratification of the Kyoto Protocol by all the Member States in 2002 in order to create "Europeanisation" of energy, according to the Energy Summit of the European Council on 4th February 2011.

The global energy mix, moreover, according to official forecasts, will probably change between 2010 and 2030, while natural gas is the fastest growing fossil fuel globally (BP 2012, Energy Outlook 2030: 31), contrary to a dramatically fall in oil and coal demand, especially crude oil (BP 2012, Energy Outlook 2030: 11).

The most important shift, nevertheless, is related to renewable energy sources to around one third of total primary energy sources consumption by 2030 (figure 7). However, because of the domination of hydrocarbons on global energy markets in the coming decades, energy security and energy policy should be based on more oil and natural gas (Proedrou, 2002: 2).

Figure 7: The global energy mix, 1970–2030



Source: BP 2012, Energy Outlook 2030: 12

These non–hydrocarbons renewable energy sources, with the least greenhouse gases and much greater environmentally friendliness (acceptability) (D. D'haeseleer, 2005: 50) take advantage of the four major global energy security indicators (which will be dealt with in Chapter 5), to a great extent, while different kinds of them are available in every community (availability) but not always commercially. The developed countries, mostly, get access to these because of better high–tech capabilities (accessibility), however, they are generally more costly than other energy sources (BP 2012, Energy Outlook 2030: 41) (affordability) in terms of capital costs and investment (K. Sovacool & Lim, 2011: 418).

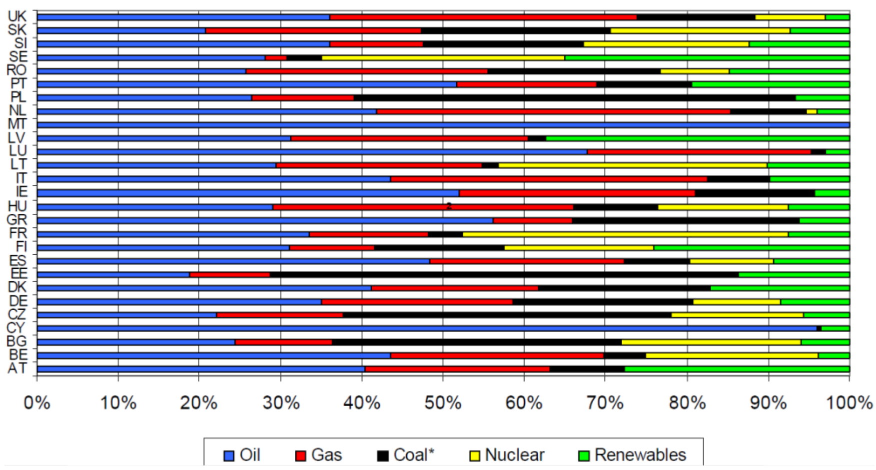
According to Eurostat 2011 (figure 13), the main EU's renewable energy sources producers in recent years have been Denmark, France, Sweden, Italy, Spain and the UK. Nevertheless, each of the EU–27 has a separate renewable energy sources portfolio to use, one or more of which in its own energy mix, influenced by a number of factors ranging from resource cost and internal laws, such as legislation over curbing nuclear energy production in some countries (Belkin, 2008: 21) to the scale of economic development and prosperity of each (Peimani, 2011: 2).

Austria and Latvia, for instance, prefer hydro power more, whereas the southern European countries, like Italy, Spain, Portugal and Greece mainly desire photovoltaic solar energy, and Germany, as the global leader of solar energy (lovass, 2009: 318–335), bio–diesel (European Commission, 10th January 2007: 14) is the leading country amongst the EU–27 regarding research programme on UG (Oil & Energy Trends, July 2011: 8).

Furthermore, Sweden, Spain, Italy, Denmark (IEO, 2011: 76) and the UK prioritise wind (IEA 2010, the UK: 21), but Germany is leading in the use of this kind of renewable energy (lovaas, 2009: 318–335), though Italy, Sweden, Hungary, France and Germany are the major producers of geothermal heat in Europe (European Commission, 2007a and 2007b), and some other EU's members have decided to develop the least–cheap clean coal–burning process (Belkin, 2008: 22).

The Eurostat in its report in May 2011 announced (figure 8) that, on the basis of 20/20/20 by 2020 level approved by the European Council on 8th and 9th March 2007, Lithuania, Sweden, Austria and Finland use renewable energy sources in their own energy mix at more than 20%, while Denmark, Romania, and Estonia have employed it in their mix of energy at between 10% to 20%. As a result, renewable energy sources in nearly 19 EU member states out of 27, was used at levels between nil to 10% of the energy mix in 2009.

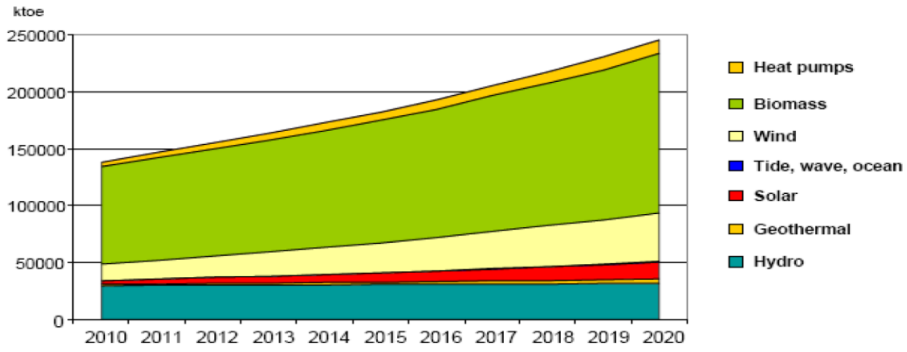
Figure 8: The EU's Energy mix, consumption by product, in 2009



Source: Eurostat May 2011, the DG ENERGY of the European Commission's Market Observatory for Energy and Key Figures, June 2011: 13

According to the European Commission (2011: 29), biomass, wind and hydro are the technologies which will progress most rapidly in the EU by 2020 (figure 9).

Figure 9: Renewable energy sources in the EU, 2010–2020



Source: Eurostat May 2011, the DG ENERGY of the European Commission's Market Observatory for Energy and Key Figures, June 2011: 29

According to European Commission (COM (2004) 366) the share of green energy (renewable energy sources) in total primary energy sources should reach 12% in 2010 and also on the basis of European Commission, Green Paper on 29th November 2000 (COM (2000) 769 final), this share should increase up to 15% by 2015 and also 8% for bio–fuel by the same date. This body in different documents, like "renewable energy sources Roadmap" (European Commission, 2007a), has insisted on achieving an ambitious (European Commission, 10th January 2007: 14; The EU's Road Map for 2050, 2011: 2) target of 20% renewable energy sources in the EU's energy mix by 2020.

While energy generation has largely remained a domain of national sovereignty, environmental and greenhouse gases legislation has been heavily impacted by EU directives (Cole, 2010). So, the Proposal for a Directive on renewable energy sources, approved on 23rd January 2008 in Brussels, has specified each of the EU–27's renewable energy sources share in total primary energy sources by 2020. The table 1 illustrates that this share is set to rise from 9.2% in 2006 (Eurostat Statistical Book, ISSN 1831–3256, 2009: 132) to 20% up to the end of the current decade.

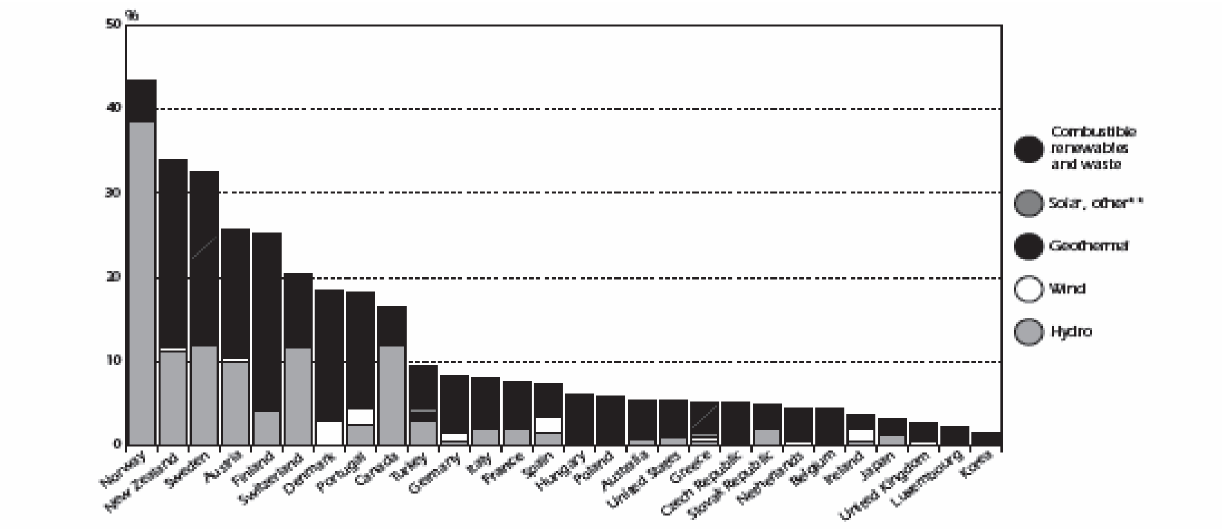
Table 1: Share of renewable energy sources target in final consumption in the EU's member states, 2005–2020

	Share of energy from renewable sources in final consumption of energy, 2005	Target for share of energy from renewable sources in final consumption of energy, 2020
	(S2005)	(S2020)
Belgium	2.2%	13.0%
Bulgaria	9.4%	16.0%
Czech Republic	6.1%	13.0%
Denmark	17.0%	30.0%
Germany	5.8%	18.0%
Estonia	18.0%	25.0%
Ireland	3.1%	16.0%
Greece	6.9%	18.0%
Spain	8.7%	20.0%
France	10.3%	23.0%
Italy	5.2%	17.0%
Cyprus	2.9%	13.0%
Latvia	34.9%	42.0%
Lithuania	15.0%	23.0%
Luxembourg	0.9%	11.0%
Hungary	4.3%	13.0%
Malta	0.0%	10.0%
Netherlands	2.4%	14.0%
Austria	23.3%	34.0%
Poland	7.2%	15.0%
Portugal	20.5%	31.0%
Romania	17.8%	24.0%
Slovenia	16.0%	25.0%
Slovak Republic	6.7%	14.0%
Finland	28.5%	38.0%
Sweden	39.8%	49.0%
United Kingdom	1.3%	15.0%

Source: Eurostat Statistical Book, ISSN 1831–3256, based on COM (2008) 19 final, 2008/0016 (COD), 2009: 126

Congressional Research Service (CRS) in its recent report issued on 13th March 2012 argues that the EU's growing need to shift fuels in order to achieve the target of the climate change policy is a major energy challenge during the coming years (CRS Report, R42405, 13th March 2012) particularly given the relatively high price of renewable energy sources technology, as the main reason behind its slow growth in the Union energy market (Proedrou, 2012: 12) compared to the increasing demand for the traditional energy sources (European Commission, 10th Jan 2007: 13), necessitating huge investment, up to €1 trillion in new technologies by 2020 (EU energy 2020: 2; CER 2011: 7; CRS Report 2012), while it has dropped since 2008 by 10% and the euro–zone crisis could be an important obstacle in this respect (Buchan, 2011: 5).

Figure 10: Renewable energy sources percentage in total primary energy sources in the IEA's member, 2008

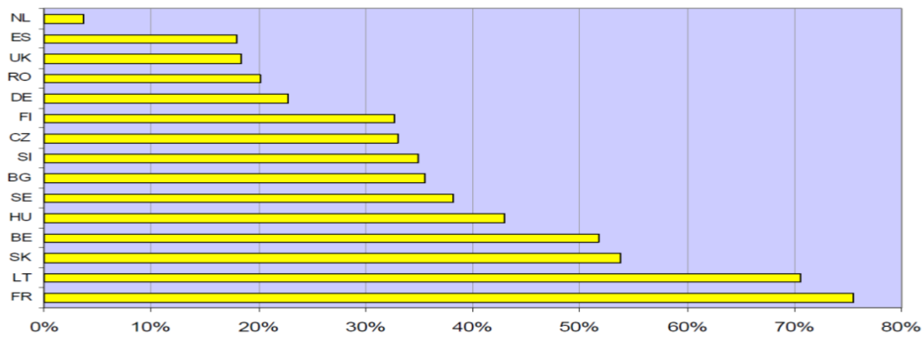


Source: Energy Policies of IEA Countries, France, 2009: 89

In addition, most of these renewable energy sources, like solar, hydro and wind, are irregular and different in European countries (figure 10), so this kind of energy is not a comprehensive solution in the short– and mid–term (Kandiyoti, 2008: 235) and also based on table 1, most of the EU's member states have a long way to go to achieve the renewable energy sources target for 2020, while 16 out of 27 should promote their own renewable energy sources use between 200% to more than 1250% by the end of the current decade.

Regarding nuclear power, there are different views over using of this kind of low– carbon fuel in the EU. While one third of regional electricity was generated by approximately 175 nuclear reactors, especially in France, Denmark, the UK, Sweden, and Spain, based on Eurostat 2011 (figure 11), some other European countries, such as Italy, Bulgaria, Lithuania, Poland and Slovak Republic decided to build new reactors, preferring to import uranium from the reliable countries, like Canada and Australia, rather than fully depend on Russian gas (Checchi et al. 2009: 28). However, a number of EU members, like Germany, as the second EU country with nuclear power generation (Rosner, 2009: 160–176), Belgium, the Netherlands, Sweden and even Spain, have committed to phase out their nuclear reactors by 2020, replacing them with gas–powered facilities, due to the considerable cost of online nuclear reactors, roughly €2 to 3 bn for each without showing any return of the initial capital before 15–20 years (Checchiet al. 2009: 29). There is also the controversial nature of nearly 40,000m^3 of radioactive waste produced annually in the EU (Checchiet al. 2009: 29), as well as its potential irreversible damage, such as what happened in Chernobyl (USSR–1986), the Three Mile Islands (the US–1979), Tokai–mura (1999), Forsmark (2006) and particularly after Fukushima Daiichi disaster (Japan–2011) (Belkin, 2008: 22).

Figure 11: The share of Nuclear in National Electricity Generation in 2009 (in %)



Source: Eurostat May 2011, the DG ENERGY of the European Commission's Market Observatory for Energy and Key Figures, June 2011: 21

Accordingly, the IEA forecasts that electricity generation from nuclear power within the EU will decrease from 31% to 21% by 2020 (IEA 2008, The EU Review).

The high–tech and costly nuclear fusion, alternatively, without any dangerous waste, such as the French $10 bn project, currently under construction has been considered (Valentine, 2011: 56–74), but it is assumed it will be used commercially only at least after 2030 (World Energy Council Report, 2007) and even after 2070 (D. D'haeseleer, 2005: 52).

K. Sovacool and Lim argued (2011: 418) that the nuclear energy is not wholly in accordance with the energy security indicators (this will be addressed in Chapter 5), so while uranium reserves are situated in a number of countries, mostly reliable ones (availability) with some constraints to access to advanced technology (accessibility), it has some nuclear waste with a high sensitivity against any attacks or natural disasters (acceptability) with extremely high capital and operating costs (affordability).

Following the European Commission's Green Paper 2000, energy efficiency has become one of the most notable pillars of the EU's energy policy that impacts on its energy security in the future, being underscored in some other documents, such as "the EU's Energy Security and Solidarity Action Plan" (European Commission, 2008f), as well as the "20/20/20 by 2020". However, according to the EU Commissioner for Energy, due to the current regional circumstances, the Union will reach only 9% in energy savings instead of 20% by 2020 (Oettinger, 10th November 2010: 2), while some other energy experts, such as Gal Luft argues that the EU could not solve its energy problems just with renewable energy sources and energy efficiency (Luft & Korine, 2009: 565).

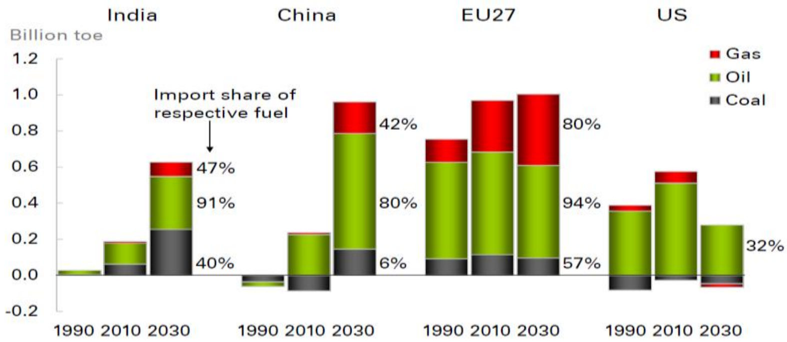
As stressed by the IEA in its special report in 2011, entitled "Are we entering the Golden Age of Gas?", natural gas is rapidly becoming the key energy source of the future at faster rates than either coal or oil, in particular in the EU–27 (figure 12), both in percentage terms and volumes (OPEC Energy Outlook 2011: 54).

A key element of the EU's energy supply strategy has been to shift to a greater use of natural gas (CRS Report, 2012), leading to publication of the Green Paper on Security of Supply (2000: 44), in which the European Commission emphasised natural gas, compared to other fuels.

Unlike oil, as the global commodity, natural gas is a regional product with mostly regional buyers and sellers (CRS Report, 2012) whereas, nearly 11 member states out of the EU–27 import the total of their own gas needs and 9 more import more than 80% of their required natural gas from other suppliers. As a result, the whole of the Union's countries are the natural gas importers, excluding Denmark and the Netherlands (figure 24), so, natural gas will be the "Achilles heel of the EU's energy security", according to Herbert Ungerer (2007: 2), DG ENERGY for the European Commission.

The Green Paper 2000 also anticipated a greater reliance on imports in the future, around 80% of natural gas needs in 2030 (BP 2012, Energy Outlook 2030: 79), so energy security within the EU means "security of gas supply" (CER, 2011: 83; Luft & Korine: 2009) whereas the shortest way aims to ensure security of supply is primarily through diversification of gas suppliers (G. Victor & Hayes 2006: 319–357).

Figure 12: The shares of global fossil imports, 1990–2030



Source: BP 2012, Energy Outlook 2030: 78

"Diversification" of energy exporters and sources, including hydrocarbon and non–hydrocarbon alongside expanding the energy links between the European network and suppliers and ultra–regional cooperation with energy suppliers (European Commission, 7th Sep 2011: 2–3; European Commission Working Paper 2011: 2) is another sub–category of security of supply, having been addressed in the EU's energy policy and brought to different documents. In its proposals, the so–called "energy policy for the enlarged EU, its neighbours and partner countries" in 2003 (COM 2003, 262 final: 18), the European Commission tried to focus on integrating other neighbouring suppliers into the internal energy market and in "Energy Action Plan for 2010 to 2014" (2010: 1), the European Commission has placed unprecedented (Bosse & Schmidt–Felzmann, 2011: 480) emphasise security of supply and external dimension of the EU's energy policy. As a result, diversification of gas routes towards the EU is essential for improving its security of supply (Regulations over EU safeguard security of gas supply, 2010: 2).

On the other hand, some of the pivotal tenets of external energy policy of the Union have remained uncertain as the EU has made progress in carrying out of its new energy initiatives (Young, 2009: 49).

Herbert Ungerer (2007: 9) argued security of supply has two internal and external dimensions, that the Union needs to have the stable ultra–regional energy partnerships, simultaneous with competitive, integrated and liberalised markets, as well as increasing the share of renewable energy sources in total primary energy sources alongside energy efficiency, all leading to sustainable reduction of supply risks.

The internal dimension of security of supply, as the third side of the EU's "energy trinity", is associated to the development of the single European gas market, as the "EU's energy policy heart" (Rosner, 2009: 160–176), having primarily started in 1993 by the European Commission (R. Odell, 2002: 421 & 510), but the European Council's liberalisation and Gas market Directive 1998/30/European Commission and also gas market Directive 2003/55/European Commission, adopted the main rules to create a more transparent competitive gas market with non–discriminatory third party access (Eurostat Statistical Book, ISSN 1831–3256, 2009: 4) by 2015 in order to put an end to the "energy islands" (Buchan, 2011: 17).

The EU's Third Gas Directive, which was adopted in 2009 and implemented in March 2011, also seeks to strengthen third party access requirements (Platt's International Gas Report, No. 624, 25th May 2009: 10–12), though with the enlargement of the EU towards the Eastern European countries, the completion of an internal market depends more and more on non–European gas suppliers (Roze, 2007: 6).

So, the number of natural gas and LNG suppliers with sufficient gas supplies plays an important role in this process, being emphasised in the 9th paragraph of the Council's Directive on 26th April 2004/67/European Commission, "Security of Supply Directive". Nevertheless, in the 10th paragraph, there was insistence on "ensuring continued investments in gas supply infrastructure, including pipeline and LNG facilities".

Since 1950, supply costs have been problematic (R. Odell, 2002: 431) and this point was emphasised during the first ever the Heads of the EU Governments' summit on 4th February 2011 (Buchan, 2011: 5), whereas the liberalisation of the gas sector, as a complex process, according to the President of Eurogas (Bosmans, 2007: 3) improves access to different natural gas and LNG suppliers (European Commission, COM (2002) 488: 11–12), with affordable prices (European Commission, COM (2002) 488: 7), but needs to develop a common approach to security of supply within the EU's internal gas market, according to the Council's Directive on 26th April 2004/67/European Commission. It is also necessary to centralised the energy decision–making within the Union (Checchi, et al. 2009: 22).

However, some argue (Taylor et al. 2005: 360) that market liberalisation with lower gas prices, due to competition, has a negative effect on energy efficiency by increasing energy consumption and produces conflict between environmental objectives and economic considerations (R. Odell, 2002: 462).

Nevertheless, Karen Sund (annex 1) believes (interview on 8th April 2012) that as long as the EU concentrates more on gas in a scenario with low prices, the policy of diversification and "trans–European energy networks" (Sascha Muller–Kraenner, 2007: 93) is more important to import the least expensive natural gas and LNG. Nonetheless, the producers will prefer other lucrative markets with higher prices and also the investors might be interested in investing into the areas with high return.

In addition, in such a gas market, arbitrage (M.Jaffe et al. 2006) and spot contracts with short–term gas trading grew more, rather than long–term contracts or take–or–pay (Checchi et al. 2009: 23), having resulted in some important gas exporters' reactions, such as Russia and Algeria. They argue that the short–term contracts mean that pricing risks move to the producers, compared with the current sharing of those risks between importers and exporters (R. Odell, 2002: 471).

The EU Commissioner for Energy believes that the external dimension of the Union's internal market should be reinforced (Oettinger, 2010: 2–5) hence, the EU's well–coordinated external energy policy and the internal energy market are complementary and promote both the EU and national energy interests beyond the Union's borders (European Commission, 7th September 2011: 17).

Prof. Van der Linde, Director of the Common Foreign and Security Policy in the CIEP in the Netherlands, believes without a this grand policy, and a more strong energy diplomacy (Chevalier J.M, 2006: 19) the Union's external energy policy would be less effective and even slower (Van der Linde, 2007: 11 & 12) and the European Commission has indicated this point in different documents, such as one produced 10th January 2007. Sascha Muller–Kraenner (2007) also believes that energy could change foreign policy during the current century.

The European Council and the EU's high–profile officials regarding Common Foreign and Security Policy are the main bodies responsible for the Union's energy security, in general, and security of supply, in particular (Rosner, 2009: 160–176), whereas the High Representative of the Union for Foreign Affairs and Security Policy (HR), as the deputy for the European Commission, and also this body play an important role in this regard. The Gas Coordination Group set up in May 2006 under the Council's Directive, assists the European Commission by preparing the required data concerning the EU security of gas supply nationally and regionally with the third parties, based on "the Regulation on security of gas supply", adopted on 11th October 2010 (Regulations over EU safeguard security of gas supply, 2010: 5), as well as the share of information regarding some gas issues, such as supply disruptions (Council Directive 2004/67/European Commission) and also Network of Energy Security Correspondents (NESCO) which was created in the EU with some representatives from the member states and the Council's Secretariat in order to gather, consider and exchange the required information and data regarding the Union's energy security problems (Rosner, 2009: 160–176).

Consequently, in the "Review of the EU's Security Strategy Energy" in 2008, the Union proposed to develop its ties and cooperation with gas suppliers and transit countries, in addition to market liberalisation and integration (Council of the EU, December 2008) as in this year, Benita Ferrero–Waldner, the Commissioner for External Relations, confirmed that "a greater focus on energy in the EU's international relations is crucial to its energy security" (Brussels, IP/08/1696: 1).

2.5. Geo–politics of the EU's indigenous natural gas

Natural gas grows dramatically by the end of the next decade, unlike crude oil and coal, and production will grow in every region except Europe (BP, 2011: 47) in spite of the fact that natural gas is the most important component in the energy supply of the EU (Regulations over EU safeguard security of gas supply, 2010: I).

The history of natural gas in Europe started with the discovery of the Groningen field in the Netherlands in 1959. Later, natural gas fields were discovered and developed on the British shelf. In 1965, Britain and France both started importing LNG from Algeria. In the mid–1960s Algeria started exporting natural gas through pipelines to the European continent. Spain and Italy followed in 1970 by starting to import LNG from Libya, and during the 1970s pipelines brought gas from the former Soviet Union and Norway to continental Europe. In the late 1990s and the first years of the new millennium LNG supply grew toward the EU. As of the first January 2012, proved world natural gas reserves, based on Oil and Gas Journal report, were estimated at 3,330,137 bcf, sufficient for 63 years of production and at least 75 years of the current consumption (IEA Special Report, 2011: 7).

In addition, global gas demands will reach 5.1 tcm in 2035, 1.8 tcm more than in 2011, because of its flexibility, abundant, technological advances in global trade, extensive use in power generation, as well as environmental benefits compared to other fossil fuels, like coal and oil (IEA Special Report, 2011: 7–8).

According to BP, June 2011, and Oil and Gas Journal (annex 20), by the end of 2010 and 2011, the EU would hold less than 1.3% of global gas and the UK is among the producers of gas within the EU with 0.1% global natural gas reserves, while its reserves at the end of 1990 and 2000 were 0.3% and 0.2% of the world's natural gas deposits, respectively. The Netherlands is the most important EU member with 0.6% global natural gas reserves and Norway, as the non–EU country holds 1.1.% natural gas reserves worldwide (BP Statistical Review of World Energy June 2011: 20).

Many EU countries have only limited domestic reserves of natural gas, and are therefore dependent on a number of pipelines and LNG exporters to secure their supplies.

Europe has domestic natural gas reserves, concentrated in off–shore areas of the North Sea countries, including the UK, Norway, and the Netherlands, as well as on–shore fields in the latter country alongside France, Germany and Italy. However, more than half of these reserves have been extracted and the North Sea gas fields are in decline (Norwegian Facts 2007: 82).

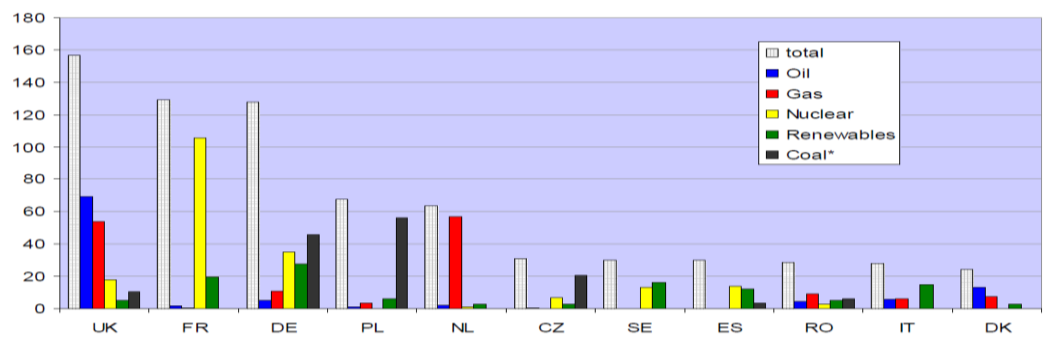
For the EU, the share of imported natural gas will continue to rise as North Sea resources are depleted. Hence, with indigenous natural gas production decreasing each year alongside the increased production costs, the security of gas supply has become a major issue in European energy policy (King & Spalding, 2006: 2).

The very large natural gas Groningen field made the Netherlands an important supplier in the EU, so this country exports over half of its production to other European countries. There are some recoverable reserves left on the Norwegian shelf, including Troll, Ormen Lange and Barents Seas, similar to the Snohvit natural gas field along with Russia's field at Shtockman (Belkin, 2008: 19).

According to BP 2011, EU gas production in 2000 was close to 232 bcm, however this number was close to 175 bcm in 2010, 5.5% of global gas production (BP Statistical Review of World Energy June 2011: 22) with the most gas production decrease in the future, globally (IEA Special Report, 2011: 27).

Figure 13 illustrates that the main EU's gas producers have been the Netherlands (2.2% global production), the UK (1.8%), Denmark, Germany and Romania (0.3%), Italy (0.2%), and Poland (0.1%). Norway, as the non–EU country and the second–largest exporter of natural gas to the EU, must be added with its 3.3% global production. Based on EIA, since 2010, Spain, Italy, France, Germany, and the UK have changed to net natural gas importers within the EU (EIA 2011, Key World Energy Statistics: 11).

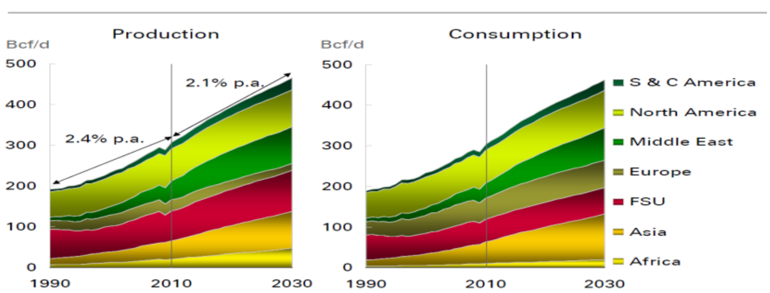
Figure 13: The main producers of energy in the EU in 2009 (in Mtoe)



Source: Eurostat May 2011, the DG ENERGY of the European Commission's Market Observatory for Energy and Key Figures, June 2011: 18

Based on figure 14, the gap between production and consumption varies by region and fuel. European net natural gas imports, among the other industrialised and also new emerging economies, will dramatically rise, while domestic production will decline and regional gas consumption rise. So, this gap between European production and consumption is clear and the security of supply of natural gas would be much more important for this region in comparison with others (BP, 2011: 73).

Figure 14: Global natural gas production and consumption, 1990–2030

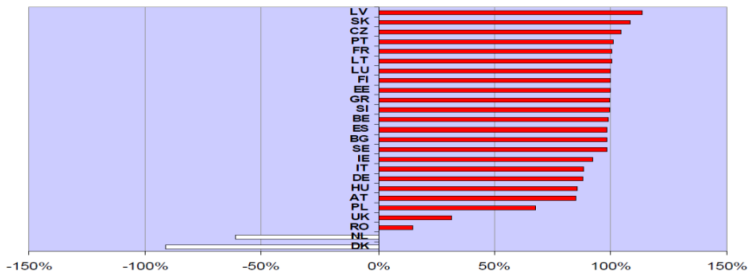


Source: BP 2011, Energy Outlook 2030: 46

The EU's member states are strongly reliant on the import of fossil fuels, while growing energy consumption, particularly natural gas, is clear among them, however gas markets within this region are largely different between one country and another (Dorsman et al. 2011: 88–91).

In 2009, as it is shown in figure 15, Denmark and the Netherlands were the only gas exporting countries among the EU–27 and could be expected to remain so at least until the end of 2018 and 2020, respectively (Denmark Oil and Gas Security, IEA 2011: 3).

Figure 15: Gas import dependency in Member States in 2009



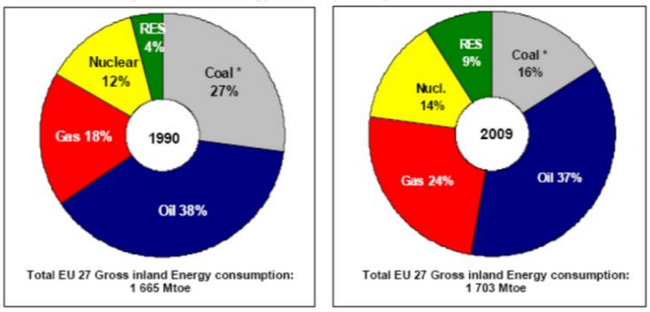
Source: Eurostat May 2011, the DG ENERGY of the European Commission's Market Observatory for Energy and Key Figures, June 2011: 10

However, according to EIA outlook published in 2011, the largest decreases in regional reserves throughout the world, attributed to Europe, including notable declines for Norway, Denmark, and the UK, which in combination saw a 14% decline in reserves just from 2010 to 2011 (EIA, International Energy Outlook 2011: 38). As a result, all of the European gas producers have been in decline since 2000, excluding Norway, the Netherlands, and, to lesser extent, Poland. However, annex 8 shows that EU's gas consumption has increased from more than 440 bcm in 2000 to nearly 492.5 bcm in 2010 or 15.5% global gas consumption (BP Statistical Review of World Energy, June 2011: 23).

Europe's unconventional gas resources are also significantly bigger than its conventional gas. However, the concrete prospects for unconventional gas production, in particular in the EU, will remain uncertain until around 2020 (BP, 2011: 55). The environmental impact of unconventional gas production is among the genuine concerns. Moreover, unlike the US, European rock strata containing unconventional gas resources are located more deeply in the earth and beneath the groundwater. While this may raise the costs of exploration drilling, it also lowers any risks of groundwater contamination (CER, 2011: 88).

Natural gas consumption in the EU has grown from 18% in 1990 to 24% in 2009, based on figure 16, primarily as a result of increasing consumption in the electric power sector. Recent actions by some European governments to reduce their reliance on nuclear power in the wake of Japan's Fukushima Daiichi nuclear disaster are likely to provide a further boost to natural gas use even in electricity generation (Platts International Gas Report, 2011: 8 &10).

Figure 16: EU's gross inland energy consumption by fuel in 1990 and 2009



Source: Eurostat May 2011, the DG ENERGY of the European Commission's Market Observatory for Energy& Key Figures, June 2011: 11

Thus, the EU is the world's largest energy importer, and Russia, Norway, as well as Algeria represent together 85% of the EU gas imports and this region will increasingly compete along with other importing countries and regions for natural gas. (European Commission Working Paper, 2011: 2). Hence EU will be the world's largest gas importer by 2030 (Davidson, 2012) raising the gas import dependency of the region from 64% in 2009 to over 80% by 2020 (Eurostat 2010; Wicks, 2009: 47). The EU has taken steps to increase "Europe–wide production" and the use of alternative resources and renewable energy sources.

2.6. The EU's natural gas demand–supply gap in the future

The EU imports its gas needs through pipelines and LNG, so this trend will continue in the future. However, the volume of imports will depend on some factors, particularly the effectiveness of the 20/20/20 targets by 2020 and beyond that, particularly the rate of renewable energy sources growth, as well as energy efficiency within the Union.

Accordingly, two main gas scenarios could be perceived for the future, as follows:

- ✓ Scenario 1: Strong growth in natural gas demand:

Based on this scenario, the increased demand for natural gas must be met by non–EU suppliers with an affordable price (CIEP 2008: 67), while European indigenous natural gas reserves are limited and declining. This will require massive investment in production and transportation capacity. Based on 20/20/20 by 2020 and EU Energy Policy targets, if fuel efficiency and renewable energy sources grows by 10% of final energy consumption, rather than 20% until the end of the existing decade, the EU will need to import up to 730 bcm/y of natural gas by 2020, according to European Commission, DG TERN (2007) and OME (2010) scenarios, while this number could increase to 800 bcm/y by 2030. Nonetheless, the volume of regional gas demand in 2010 was 522 bcm, according to the Head of Unit Electricity and Gas within the European Commission, DG TERN (interview, 2012).

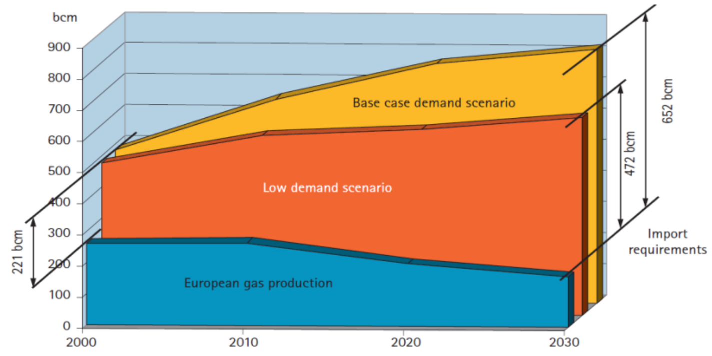
- ✓ Scenario 2: Low growth in natural gas demand:

This scenario will also depend on the rate of renewable energy sources and energy efficiency growth in the EU. According to CIEP (2008), if renewable energy sources and energy efficiency within the EU grow to 15% and all of the planned external pipeline projects towards this region materialize, so the EU demands would be 600–640 bcm/y in the second half of the current decade. The European Commission, DG TERN (2007) and OME (2010) scenarios confirmed these approximate volumes with slight changes, while the figure could rise to 670 bcm/y by 2030.

According to the European Commission, the natural gas imports in the EU countries will increase from 221 bcm in 2000 to 472 bcm in 2030 in the low demand scenario and reach to 652 bcm in the high demand scenario (figure 17).

However, the Commission predicted that the continental production will drop dramatically by 2030.

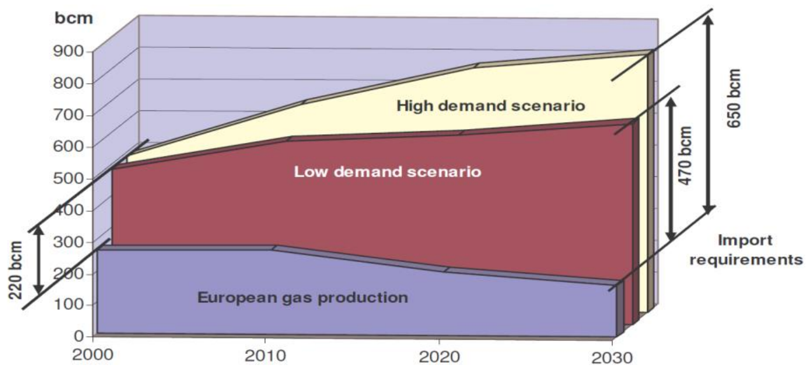
Figure 17: European Commission's scenario regarding the EU gas demand, 2000–2030



Source: European Commission, EUR 22581, 2007: 19

On the basis of OME's scenarios being very close to the European Commission prediction, gas import in Europe–34, including the EU–27, Switzerland and all the Balkan countries, will rise to 470 bcm in 2030 in the low gas demand scenario and could increase to 650 bcm in the high demand scenario (figure 18). This represents a doubling, in the former scenario, or a tripling, in the latter scenario, of imports from 2000 until 2030. European gas production would also be in decline seriously, as well.

Figure 18: OME's scenario regarding the Europe-34 gas demand, 2000–2030



Source: Hafiner et al, OME, 2010 : 2

On the other hand, the EU produced 178 bcm of natural gas in 2010, based on the Head of Electricity and Gas within the European Commission, DG TERN (interview, 2012) and this will probably fall to 130 bcm in 2015 (CIEP, 2008). The

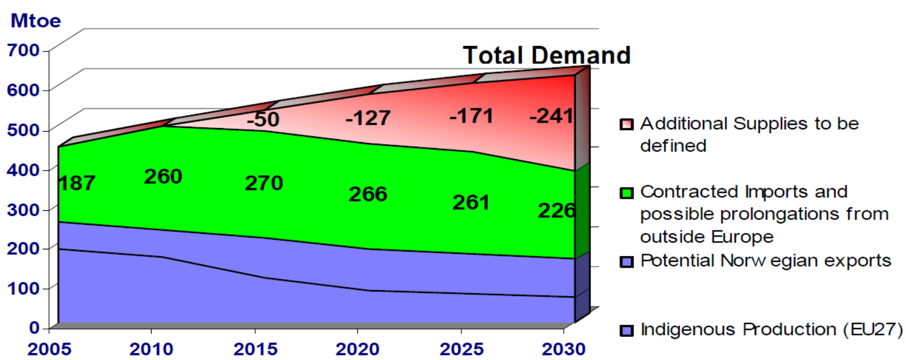
European Commission, DG TERN (2007) and OME (2010) argued that this volume alongside Norwegian gas production will reach 180–220 bcm/y in 2020 and around 150 bcm/y in 2030 (figure 33).

As can be seen in figure 30, Europe continental production (including Norway) will drop from nearly 280 bcm/y in 2010 to 222 bcm/y in 2020. In other words, while European production accounted for 59 % of supplies to EU gas markets in 2010, it is expected to drop to a third by 2020 and to a quarter by 2030 (Eurogas, 2010: 5). It is important to mention that European gas demand will rise by 43% by 2030 (Eurogas, 2010: 5).

On the basis of figure 19, the EU's natural gas and LNG contracts with other suppliers will start expiring since 2015 and by 2030 it would be nearly five times more than the middle of the current decade. So, as figure 5 demonstrates, all contracts will terminate before 2030.

Furthermore, European production (comprising Norway) will decline from 233 Mtoe/257 bcm in 2010 to 185 Mtoe/204 bcm in 2020 and then to 158 Mtoe/174 bcm in 2030 (figure 19).

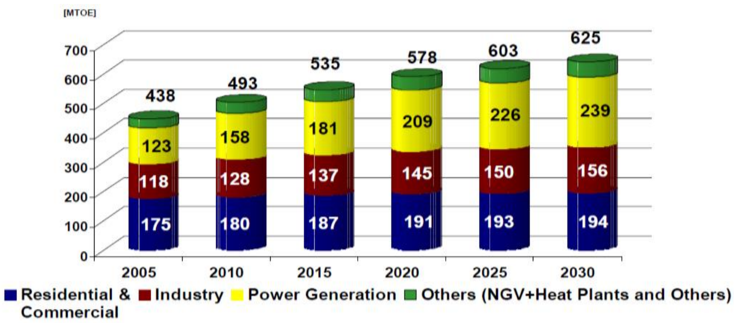
Figure 19: Eurogas' scenario over the gap of supply–demand in the EU, 2005–2030



Source: Eurogas 2010, "Natural gas demand and supply in long Term Outlook to 2030": 3

Natural gas consumption in EU member states is expected to increase from 438 mtoe/482 bcm in 2005 to 625 Mtoe/690 bcm (figure 20) in 2030, which is an increase of 43%. The share of natural gas, moreover, in the European total primary energy sources demand that increased from 18% in 1990 to 24% in 2009, will rise to 30% up to 2030 (Eurogas 2010: 3).

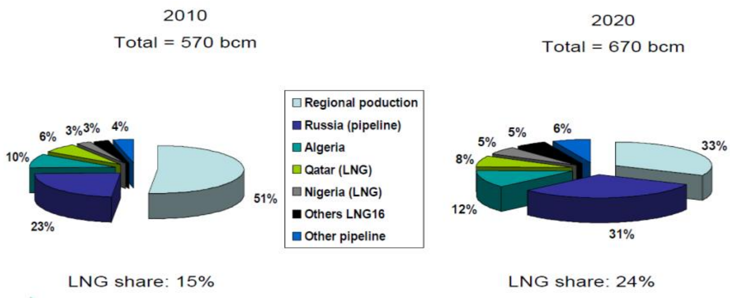
Figure 20: EU–27 natural gas demand outlook by sector, 2005–2030



Source: Eurogas 2010, "Natural gas demand and supply in Long–Term Outlook to 2030": 3

CEDIGAZ in its report in June 2011 illustrated that the amount of the EU gas demands will be nearly 670 bcm in 2020, while share of LNG will rise from 15% of regional gas imports in 2010 to 24% in 2020. As a result, while the EU imported 80 bcm LNG in 2010, based on the Head of Unit of Gas within the European Commission, DG TERN (interview, 2012), this volume will rise to approximately 160 bcm by 2020 (figure 21). BP (figure 24) also forecasted that the EU's LNG demand will soar to at least 230 bcm/y by 2030. This volume could increase from 220 to 300 bcm/y by 2030 in low and high demands, on the basis of figures 22 and 24, while Europe will need extra gas with nearly between 80–100 bcm/y by pipelines. Nevertheless, European continental production (including Norway) will drop from nearly 280 bcm/y in 2010 to 222 bcm/y in 2020. In other words, while European production accounted for 59% of supplies to EU gas markets in 2010, it is expected to drop to a third by 2020 and to a quarter by 2030 (Eurogas, 2010: 5). It is important to mention that European gas demand will rise by 43% by 2030 (Eurogas, 2010: 5).

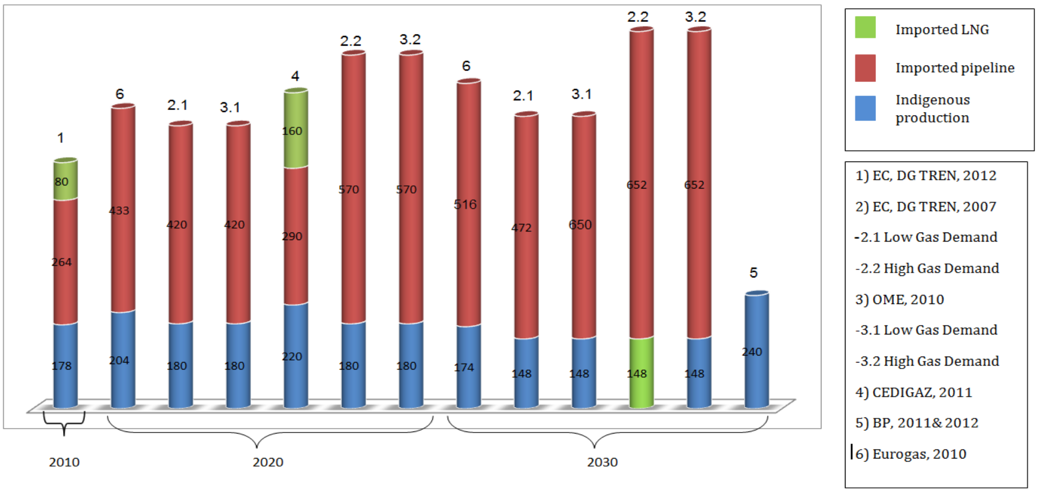
Figure 21: European natural gas and LNG supply prospects



Source: CEDIGAZ (2011), "World LNG market: current developments and prospects", 24th June: 10

In accordance with figure 22, with all the above scenarios, it suggests a range of gas demands in the EU, from 600–750 bcm/y by 2020 and 620–800 bcm/y by 2030. Adding an estimated indigenous European gas production of some 180–220 bcm/y in 2020 and 148–150 bcm/y by 2030, these supplies from non–European suppliers are placed in the range of 420–530 bcm/y until the end of the current decade and between 480–650 by 2030. Therefore, the EU will require 120–160 bcm/y LNG by 2020 and 220–300 bcm/y until 2030, whereas the amount of imported LNG in 2008 and 2010 was approximately 50 bcm and 80 bcm, respectively. In addition, if some pipeline projects would not be operational, then the amount of LNG imported could be increased in the future.

Figure 22: The gap of supply–demand of natural gas and LNG within the EU, 2010–2030



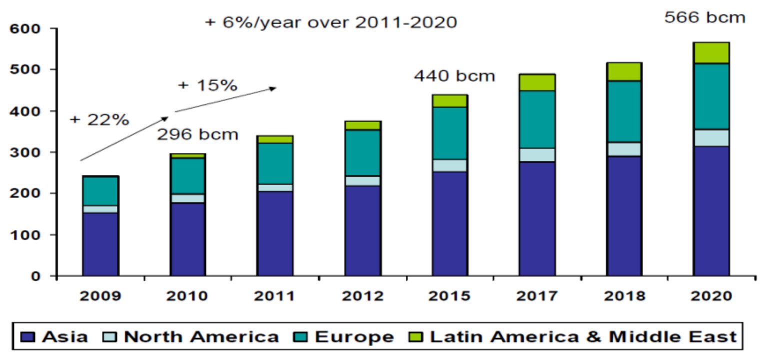
- Indigenous gas production (including Norway, except in 2010)/ EC = European Commission

Source: By Author

Global natural gas trade increased by 10.1% in 2010 and the share of world LNG shipments grew to 22.6% in the same year. LNG, as more globalized than pipeline, could be transported domestically, inter–states or inter–regionally (C. Schofield, 2011) and for the time being, accounts for 30.5% of global gas trade (BP Statistical Review of World Energy June 2011: 4). Hence, LNG capacity will increase from 270 bcm in 2008 to 450 bcm in 2015 and 540 bcm in 2020 (IEA Special Report, 2011: 45).

The CEDIGAZ report (2011: 4&10) has also estimated that LNG trade will grow faster than gas trades by pipeline, growing from 296 bcm in 2010 to 566 bcm in 2020 (figure 23). Based on figure 24, below, European market will be the main LNG market worldwide until 2020, while figure 23 shows that the most LNG demands belongs to Asia by 2020. The growing demands, particularly from newly emerging economies, and their rivals, in addition to any unexpected events, such as Japan's earthquake in January 2011, access to more LNG supplies would be a challenge for the EU in the future.

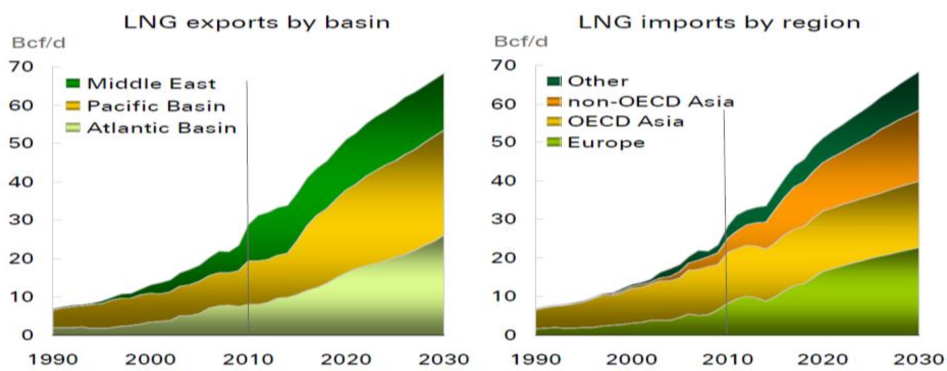
Figure 23: The world's LNG demand prospects (in bcm)



Source: CEDIGAZ (2011), "World LNG market: current developments and prospects", 24 June: 6

LNG supply is set to grow 4.4% per annum to 2030, more than twice as fast as total global gas production (2.1% p.a.), and its share in gas supply throughout the world will increase from 9% in 2010 to 15% in 2030. European and non–OECD Asia, particularly China and India, demand for LNG would be in the leading positions (figure 24).

Figure 24: LNG trade grows twice as fast as global gas production

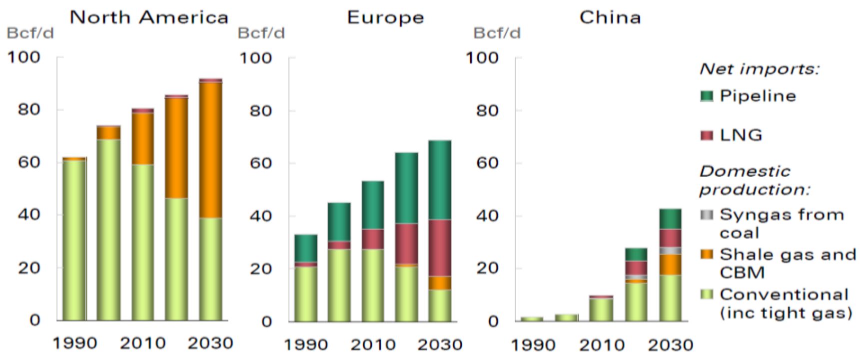


Source: BP Energy Outlook 2030, 2011: 56

However, it is expected that unconventional gas production in Europe would grow by 0.3% of global gas production by 2020 and 1.7% by 2030 (See figure 25 & annex 7).

As figure 25 illustrates, the role of LNG will rise in Europe by 40% of the total gas imports (BP, 2012: 34), while the EU Commissioner for Energy is expected to enhance the volume of LNG imported by around 24% by 2020, through diversification of LNG suppliers and routes in the future European gas market (Oettinger, 2010: 5–6).

Figure 25: Conventional and unconventional gas sources of supply by region, 1990–2030



Source: BP Energy Outlook 2030, 2012: 34

In addition, Europe's gas imports by pipelines will face some challenges, including:

- Transit risk, such as what happened in Ukraine and Belarus during 2006–2009;
- Russian domination on some of the Caspian littoral states' gas policies;
- Delay in constructing of new gas pipelines due to the geopolitical or technical constraints and complexity of negotiations with politically less–stable suppliers and transit countries.
- Permanent pipelines are expensive and need long construction times without capability of diverting to any other potential destinations, unlike LNG tankers (Sascha Muller–Kraenner, 2007: 8).

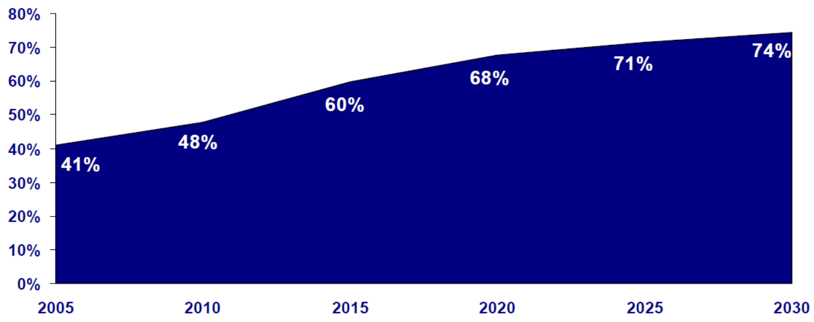
Therefore, diversification of gas supply by LNG would be critical to ease these various supply risks (RREEF Research, 2011: 3), as the producers and consumers can contact directly with each other without transit players and also interdependency and new energy relations will emerge (Luft & Korine, 2009: 13), without paying attention to geographical boundaries among the states and regions.

As a result, these reasons mentioned, alongside flexibility of LNG over the destination and shorter duration of its contracts (Wicks, 2009: 36) could lead to more use of LNG and then rising of local, national, regional and global energy security in the future (Hurst, 2009: 271–282). However, construction of gas pipelines over long distances is not economical (Wicks, 2009: 36).

In addition, LNG ports offer greater resilience than pipelines as the former can receive from different suppliers, while the latter should import generally from fixed exporters (IEA (MOSES), 2011: 26). This would require increasing supplies in the years to come from the traditional European gas suppliers, including Norway, Russia and North Africa, as well as some new natural gas and LNG suppliers.

When European production decreases, to at least 30% less than today's production by 2020, and even further until 2030 (Eurogas Long–Term Outlook to 2030: 5), gas imports will increase, compared to the current level. So, the EU will require finding new gas suppliers, in particular, more adjacent to this region. As figure 26 shows, the EU imported 41% of its natural gas and LNG demands from outside the continent, but this percentage reached 48% in 2010. According to Eurogas' estimation (2010: 6), the Union might import 68% and 74% of its natural gas and LNG demands from non–European suppliers by the end of the current and future decades respectively.

Figure 26: EU–27 natural gas and LNG import percentage from outside Europe, 2005–2030



Source: Eurogas 2010, "Natural gas demand and supply in long Term Outlook to 2030": 6

Andris Piebalgs, ex–European Commissioner for Energy, argued that the EU countries should strive to increase the number of alternative gas suppliers and more competition over gas prices, including:

1. Additional gas supplies from Russia;
2. Natural gas from Turkmenistan and Central Asia via a new pipeline through Turkey and the Balkan region;
3. Pipeline(s) from the Middle East (potentially from Qatar and Iran);
4. Additional undersea pipelines from Libya and Algeria to Italy and Spain;
5. New LNG projects from Northern Russia, North Africa, Middle East/Persian Gulf, etc.) (Piebalgs, 2008) (See more in Chapters 5 & 6).

2.7. Various external gas routes toward the EU

In the EU, natural gas has been imported mainly by pipelines from Russia, Norway and, to some extent, from Algeria, amounting to 85%, by these countries' energy giants, including Gazprom, Statoil Hydro and Sonatrach, respectively (European Commission, SEC (2011) 1022 final on 7.9.2011: 3). As European production decreases and future dependence on imports from LNG points or pipelines from more remote areas will increase, so this dependence is the EU's special concern (European Security Strategy, 2003: 3). Only diversifications of routes, LNG import terminals and interconnection grids could help to mitigate these and other related risks.

Russia is the major pipeline supplier to Europe, all of which goes through pipeline, followed by Norway. The major gas pipeline routes from Western Siberian gas fields to Western European export markets run across Ukraine. However, Russia wants alternative routes for the gas it sells to Europe, like the Yamal–Europe gas pipeline II, to reduce its reliance on routes through Ukraine and Belarus. Accordingly, North Stream gas pipeline was inaugurated in December 2011, bypassing Ukraine.

There are more than three million miles of oil and gas pipelines worldwide at an average cost of more than 1.3 million dollars per mile to build (Luft & Korine, 2009: 26). According to Eurogas 2010, the length of all pipelines within the EU–27 is 2,030,070 km, as shown in table 2 and at the end of 2009, total length of pipelines, transmission and distribution, increased by approximately 2% in comparison with 2008 (Eurogas Statistical Report, 2010: 11).

The EU in 2009 received 31% of its natural gas from Norway and partially from the UK, the Netherlands and other EU member states and 34% from Russia. The rest of EU's gas imports, 35%, came from Algeria, Qatar, Libya, Egypt, Nigeria and other exporters.

Natural gas can be transported either by pipelines or turned into a liquid, shipped by tankers and regasified at the destination in the form of LNG. Europe's gas imports are nearly 81% delivered by pipelines (Eurogas Statistical Report: 2010), however, the situation in the EU's gas market has changed considerably over the last few years with the start of the technology of liquefaction of natural gas and the importing of large amounts of LNG by tanker to Europe. LNG has been used since the

Table 2: The length of pipelines in the EU, by2010

	Total length of pipelines*
AUSTRIA	38 612
BELGIUM	69 701
BULGARIA	5 595
CZECH REPUBLIC	76 249
DENMARK	18 439
ESTONIA	2 287
FINLAND	2 990
FRANCE	229 700
GERMANY	443 000
GREECE	7 906
HUNGARY	87 157
IRELAND	12 932
ITALY	278 617
LATVIA	6 001
LITHUANIA	10 000
LUXEMBOURG	2 870
NETHERLANDS	150 700
POLAND	126 188
PORTUGAL	15 647
ROMANIA	46 899
SLOVAKIA	34 776
SLOVENIA	4 015
SPAIN	71 077
SWEDEN	3 100
UNITED KINGDOM	285 600
EU 27	**2 030 058**
SWITZERLAND	17 954
TURKEY	58 000

Source: Eurogas Statistical Report 2010: 11

1960s, particularly in Spain, the UK, Italy, France, Belgium and Greece. So far only six of EU–27 member states possess the required technology of LNG (Kulick, 2012: 14).

In addition, based on Eurogas 2010, Spain leads Europe in LNG imports, followed by the UK, France, Italy, Belgium, Portugal and Greece.

Algeria is currently the most important LNG exporter to Europe with deliveries to France, Spain, Belgium, Italy and the UK. Spain, moreover, imported LNG from Egypt.

The EU, particularly Spain and France, has consumed LNG from Nigeria since 1999. Egypt and Qatar have also increased their LNG exports to Europe mostly to Spain. The EU, moreover, receives some smaller LNG volumes from other sources such as Oman, Libya and Trinidad and Tobago (RREEF Research, 2011: 3).

Based on a CEDIGAZ estimation in 2011 (figure 21), the European gas market needed 570 bcm of natural gas in 2010 and almost 15% of the EU's net imports were delivered by LNG, nearly 80 bcm/y, and it is expected that this figure will rise to 24% by 2020, 120–160 bcm/y, and to increase by 40% until 2030 with 220–300 bcm/y, so the EU's LNG needs will rise 60% in 2020 and around 270% by 2030, compared to 2010. However, continental gas production will decline from 51% in 2010 to 33% by the end of the current decade.

Consequently, a high number of new LNG import terminals have been proposed in recent years in response to the increase in LNG demand in the EU and some of them are under construction. Nearly 80% of new facilities would be in France, Italy, and Spain in order to meet domestic use and transportation inside the region (map 1).

2.7.1. External gas pipelines toward the EU

Pipelines are expected to remain the most dominant means of gas transport in Europe by 2020, and based on table 6, if the whole of the foreseen pipeline projects materialise, they can transfer between 135–144 bcm/y natural gas to the

EU market from ultra–regional gas producers. It should be noted that, a few pipelines are currently under development, such as Langeled pipeline.

Russia has supplied its piped gas to Europe via Yamal–Europe, Nord Stream and Blue Stream. Among them, it is important to recall the Nord Stream gas pipeline connecting Russia with Germany via the Baltic Sea, inaugurated in 2011. This gas pipeline passes under the Baltic Sea, as the longest sea–bed pipeline worldwide, with no transit country's involvement, thus enabling transportation fees to be reduced and ruling out possible political risks toward Germany, the UK, the Netherlands, France, Denmark and other European countries.

Algeria has been the third supplier of natural gas, after Russia and Norway, to Europe since the 1960s. The Enrico Mattei and the Pedro Duran Farell pipelines have shipped nearly 40 bcm/y of Algerian gas to Italy and Spain (C. Schofield, 2011).

Libya supplies its natural gas to Italy through an off–shore pipeline, the so–called Green Stream (Catalano, 2011: 10). The South Caucasus Gas Pipeline (SCGP) from Republic of Azerbaijan was completed in December 2006, in parallel to the BTC oil pipeline.

Another important route under study is the gas corridor from the Middle East/Persian Gulf and the Caspian region via Turkey to Greece, Bulgaria and Italy, the so–called "South–Europe Gas Ring" or the "South Gas Corridor". The ITGI (Interconnection Turkey–Greece–Italy Pipeline), the TAP (Trans–Adriatic Pipeline), and the Nabucco compete with each other to play the main role to transport piped gas from the above–mentioned regions, especially Republic of Azerbaijan and Iran to Europe (Catalano, 2011: 9–10).

The "Mediterranean Integrated Gas Ring" or "Medgas Ring" from South Mediterranean gas reserves is another project, including connection of North African gas holders and also Trans–Saharan Gas Pipeline (TSGP) in the Niger Delta, in Southern Nigeria, to Europe, even via the Nabucco by the Arab Gas Pipeline (AGP) in Egypt (Mott MacDonald's report, 2010: 9–10). The Medgaz pipeline, moreover, has originated from Algeria to Spain, then France and the European market, followed by the Galsi pipeline, connecting Algeria to Italy via Sardinia across the Mediterranean Sea.

In addition to the continental pipelines, such as Langeled, a couple of interconnected gas pipelines are operational within Europe, like Zeebrugge between Belgium and the UK, ITG between Turkey and Greece. The Langeled pipeline (originally known as Britpipe) is an underwater pipeline transporting Norwegian gas to the United Kingdom. Before the completion of the Nord Stream pipeline, it was the longest sub–sea pipeline in the world ("Nord Stream Passes ships and bombs", the Moscow Times, 05.05.2011). The Baltic Pipeline from Norway to Denmark, Poland and then Germany via the Baltic Sea–bed with 3–5 bcm/y is also other planned European gas pipeline. The suspended Skanled pipeline was also supposed to transport Norwegian gas to Denmark and Sweden. The TAP, starting from Greece, Albania, the Adriatic Sea and Italy, is considered to be the shortest interconnection in the Southern Gas Corridor, linking Europe to new sources of gas in the Caspian and Middle East/Persian Gulf regions.

Table 3: List of the most important gas pipelines toward the EU

Project	Supplier	Via	To	Capacity (bcm)	Start-up
Enrico Mattei (The Trans-Mediterranean Pipeline)	Algeria (the Hassi R'mel field)	Tunisia & Mediterranean Sea	Italy	27–32	1983, 1990 & 2012
The Maghreb-Europe Gas Pipeline/Pedro Duran Farell	Algeria	Morocco	Spain & Portugal	8–12	1996
Yamal-Europe	Russia	Belarus	Poland & Germany	33	1997
Green Stream	Libya	Mediterranean Sea	Italy	8–11	2004

Blue Stream	Russia	Black Sea	Turkey	16	2005
Langeled	Norway	Ormen Lange	UK	20	2006
BBL[2]	Netherlands	–	UK	16–19	2006
SCGP [3]**/ BTE**[4]	R. Azerbaijan	Georgia	Turkey	6.6/ up to 20	1st leg: 2006 2nd leg: planned
Nord Stream/ NEGP[5]	Russia	Vyborg	Germany	27–55	2011
Medgas	Algeria	Mediterranean Sea	Spain	8–10	2011
GALSI	Algeria	Mediterranean Sea	Italy & France	8–10	2014
South Stream	Russia	Turkey & Black Sea	Bulgaria, Greece, Austria & Italy	63	2015
White Stream	Caspian region	Georgia & Ukraine	Romania	32	2016
ITGI	Caspian	Greece	Italy	8–10	2017
Nabucco	Caspian	Turkey	Austria	25–30	Since 2018

Source: By Author, based on: http://en.wikipedia.org/wiki/List_of_natural_gas_pipelines; European Commission (2007), "Energy corridors, European Union and Neighbouring countries", EUR 22581; Remme, Uwe & Blesl,Markus & Fahl, Ulrich (2008), "Future European gas supply in the resource triangle of the Former Soviet Union, the Middle East and Northern Africa", Energy Policy, Volume 36, Issue 5, May:1622–1641

[2] Balgzand Bacton Line
[3] South Caucasus Gas Pipeline
[4] Baku–Tbilisi–Erzurum Pipeline (Shah Deniz Pipeline)
[5] North European Gas Pipeline

If all pipelines that are planned materialised in the future, including the connection of the Nabucco to the current South Caucasus gas pipeline and the Tabriz–Erzurum pipeline from Iran, and Norway also increases its exports to Europe with the new Europipe III, along the current pipeline capacity, the EU will be faced with high import pipeline supply, up to 410 bcm by 2020 (CIEP, 2008: 67).

However, some prominent experts like Prof. Anoush Ehteshami, on 3rd November 2011, Kevin Rosner (2011: 160–176) and Kulick (2012: 14) believe that most of the projects within the Central Asia, like the EU–endorsed but delayed the Nabucco pipeline, will not happen without Russian consent, as Moscow dominates most of the Central Asia's natural gas (Delcour, 2011:121), while this country does not support natural gas and LNG diversification routes to the EU and maintains its bilateral energy negotiation with the EU members.

In addition, in August 2009, the signing of several additional protocols between Russia and Turkey, as the main transit country for gas transportation to the EU, refer to nuclear and gas energy cooperation, such as construction of the Blue Stream II. It demonstrates the closer energy bilateral cooperation that could shift the balance in favour of a more effective Russo–Turkish partnership than Turkey–the EU (Catalano, 2011: 10).

Russian–Algerian gas negotiations have been another example. In March 2006, President Putin, along with Gazprom officials, travelled to Algeria to discuss Russian participation in Algeria's future oil and gas projects, including its LNG export markets. This trend shows that Moscow is seeking to position itself to influence Algeria's future role as a major natural gas and LNG supplier to Europe (Belkin, 2008: 19).

However, EU member states have established two mechanisms in order to deal with Moscow for energy relations: the Energy Charter Treaty, which Russia has signed but not ratified in 2009, and the EU–Russia Energy Dialogue that came to realisation in 2000 (Belkin, 2008: 12).

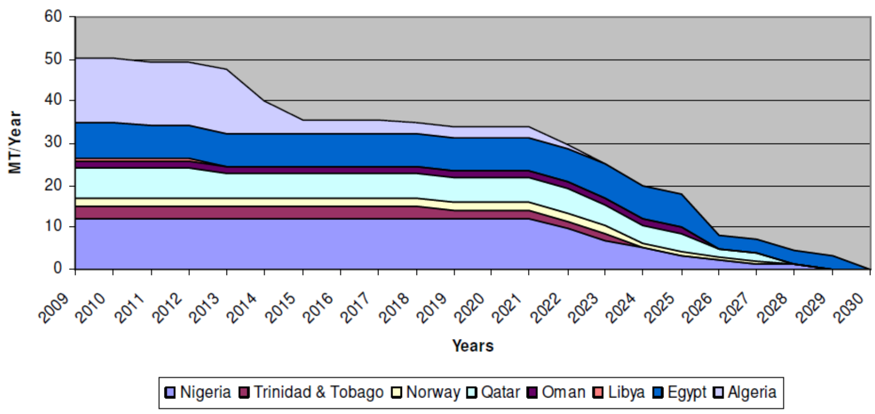
In sum, the amount of piped gas import capacity within the EU in the future, alongside the rate of implementation of the European energy policy, notably the 20/20/20 by 2020, regarding energy efficiency and renewable energy sources, will determine the amount of extra LNG imports in the medium and long terms.

By 2020, Europe will depend on foreign producers for over 80% of its natural gas, a big jump from 64% in 2009 (Eurostat 2010). Furthermore, many European countries are uncomfortable with their reliance on Russian gas giant Gazprom, and are eager to diversify their suppliers (Dorsman et al. 2011: 91).

2.7.2. External LNG routes toward the EU

On the other hand, most of the current LNG imports are on long term contracts, although some of those will come to an end at the beginning of the 2020s, such as Algeria, Oman, Nigeria, Norway, as well as Trinidad and Tobago, and then they will totally end before 2030 (figure 27). Moreover, as clarified in Chapter 5, some of the above–mentioned suppliers will face decreases or depletion of gas reserves before the end of the future decade.

Figure 27: LNG contracted to Europe, 2009–2030



Source: Mott MacDonald's report, 2010: 26

Sufficient LNG capacity, regasification terminals, transportation to other EU members alongside adequate gas storage should be available (European Commission, 2008: 6). In addition, only six out of the EU–27 possess the required technology for LNG, these being, Spain, the UK, France, Italy, Greece, and Belgium (Kulick, 2012: 14). Hence, further interconnection is necessary to transport regasified LNG into the heart of the EU members. Of course, the support of the European Commission and the EU regulators' in terms of investment in such infrastructures would be important (Wicks, 2009: 92), as it is likely that during the years to come the EU's gas market will be well supplied thanks to the completion of the LNG capacity already under construction (Wicks, 2009: 25).

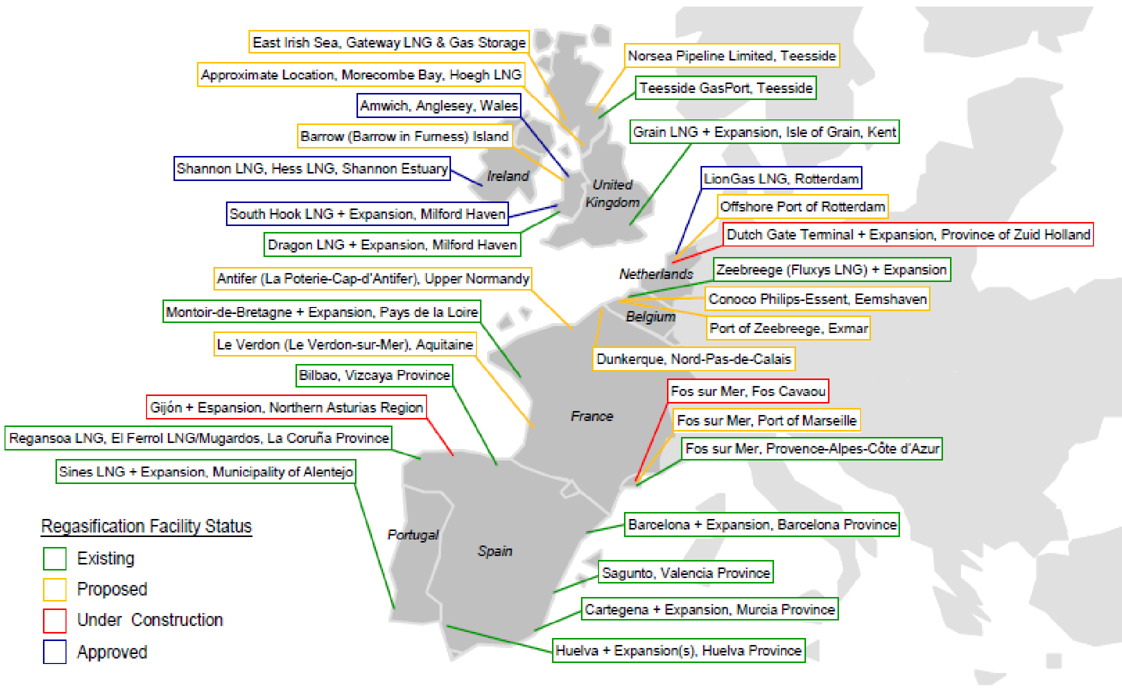
Therefore, additional gas from new suppliers will require massive investment in production and transportation capacity (RREEF Research, 2011: 6).

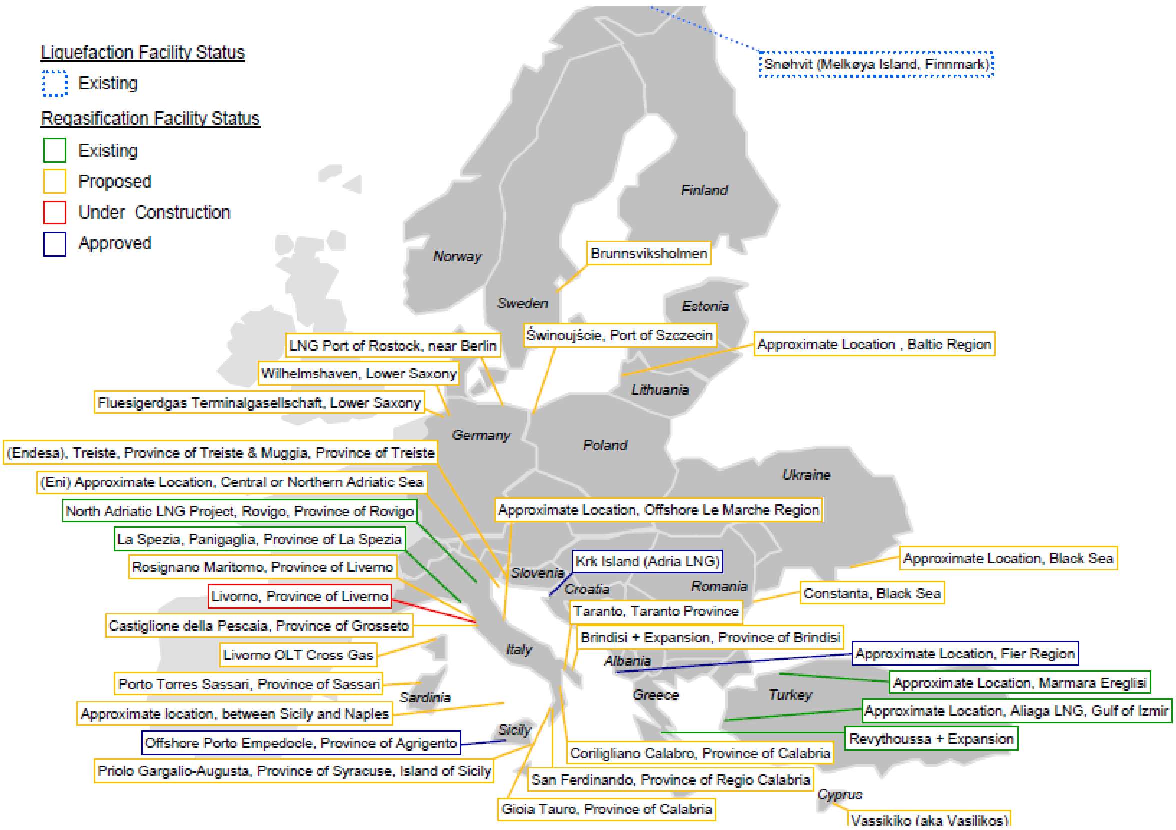
With the currently ongoing large investments in new LNG facilities in an increasing number of countries in the EU, a global LNG market is arising as well (CEDIGAZ, "Statistical Database", 2011), so that the EU's LNG regasification capacity has increased between 2004 to 2010, to 142 Mtoe/157 bcm, and will continue further until 2020 (Eurogas, 2010: 6).

A high number of new LNG import terminals have been proposed or approved in recent years in response to the increase in LNG demand and some of them are under construction. Other terminals in Belgium, France, Italy, Spain and the UK are under construction or being expanded and are due to become operational in the next three years. Some other terminals have been proposed in potentially new LNG importing countries such as Cyprus, Ireland, Germany, the Netherlands and Poland.

A number of new LNG terminals within the EU countries are under construction, while existing terminals are expanded. Once some of the LNG projects approved, planned and under construction in the EU become operational transit risks could be eased and the energy security would be significantly increased (map 1).

Map 1: Existing, proposed, under construction and approved LNG terminals in Europe

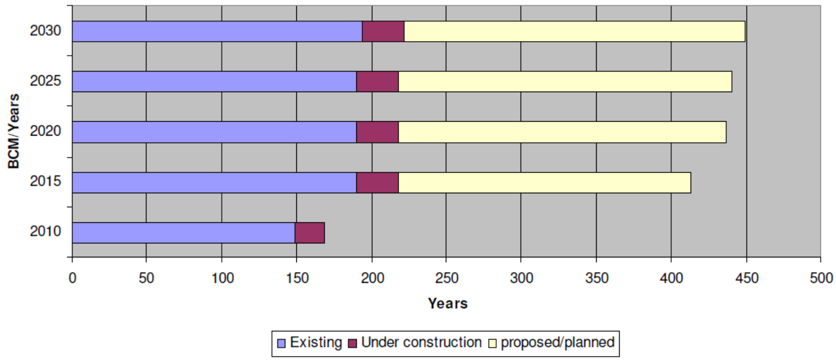




Source: PREEF Research (2011), "LNG Market in Europe": 5

There are also plans to expand many of the existing facilities but it is not expected that all of those projects will proceed before 2020. Similarly, there is a long list of proposed and new LNG terminals, as shown in figure 28.

Figure 28: LNG import/regasification terminals in the EU



Source: Mott MacDonald's report, 2010: 28

It is also expected that a few of those will actually go ahead, at least before 2020, and, if all the proposed expansions and new facilities were to be completed, the total LNG regasification capacity in the EU will reach to more than 450 bcm/y by 2030, which is nearly nine and a half times the actual imports in 2008 and 2010 (Mott MacDonald's report, 2010: 28).

In Italy, for example, there are four LNG facilities and eleven proposals for the construction of LNG terminals and three of them have already been authorised and are under construction. Spain has two LNG regasificators under construction, in addition to the current five facilities. France has authorised the construction of three more LNG terminals out of five, while the UK has six LNG projects either proposed or under construction, despite three currently active LNG facilities.

These published LNG projects would represent an additional import capacity of about 100 bcm/y by 2020 (European Commission, 2007, "Energy corridors European Union and Neighbouring Countries": 20), while the current EU's LNG import is around 80 bcm/y (CEDIGAZ, 2011). Although, some of the existing facilities are expected to be expanded in order to import more volume of LNG (De Vivies, 2005).

2.8. The EU's Challenges on natural gas and LNG imports

The EU has struggled to secure its gas supply beyond the year 2020, from both LNG and pipeline sources in the future by the above–mentioned projects. Nevertheless, it faces some challenges, as follows:

First of all, for the EU energy policy–makers, one of the main sources of concern is Russia. The gas supply cuts in 1993, 1994, 1995, 2005/2006, 2007 and 2009 to Ukraine and Belarus, as well as the war in Georgia in 2008 has shown, Russia does not seem to have abandoned its ambition of maintaining its domination on Commonwealth of Independent States (CIS), in particular their hydrocarbon resources, and also can use gas as a political weapon against Europe (Pascual & Zambetakis, 2010: 21).

These "cut–off incidents" made some EU countries aware of how much they depend on energy coming from just one huge company: Russia's Gazprom.

In addition, Russia's three major gas fields (Urengoy, Yamburg and Medvezhye) are declining and some other fields, such as the ones within the Yamal region and also the Arctic with its harsh climate and lack of infrastructure (Rosner, 2011: 160–176), need more investment (Aad Correlje et al. 2006: 542). The modernization of aged pipeline systems in transit countries, like Ukraine, is also vital (CER, 2011: 88–92). This problem could be extended by other regional issues within the Central Asia and Caspian region, such as unresolved legal status of the ownership of the Caspian Sea's gas reserves, while only Republic of Azerbaijan, Kazakhstan, and Russia have already reached an agreement over the long–term political conflict between Republic of Azerbaijan and Armenia over Nagorno–Karabaugh, and there is also the question of internal political strife in Georgia (Gheorghe & Muresan, 2011: 25–28). Therefore, diversification away from Russian gas is important for the EU in the foreseeable future (Wicks, 2009: 94–95).

Second, nearly 80% of hydrocarbon reserves are under governmental control and these states can use oil and gas as political pressure or leverage (Luft & Korine, 2009: 335–350). These countries could also force the foreign companies to operate on their territory in a partnership with their state–owned companies, such as Russian law (Bahgat, 2011: 1). As a result, nationalistic policies or possible internal instability and political turmoil (Belkin, 2008: 17–18) are perceived as major threats (see Chapter 5).

Third, the lack of a coherent European energy foreign policy with a single voice (CER, 2011: 3) and also less growth in forming a regional integrated market are the main "inherent dilemmas" (Schweiger & Wittlinger, 2009), despite the Commission's policy on the Single Market agenda in 2007 and more consensus on this market construction (European Commission, 2009b: 4). It seems that member–state behaviour has become more geopolitical, rather than enshrining the internal energy market rules (Young, 2009: 4).

Although the Lisbon treaty commits the EU to secure the energy supplies of the Union, there has not been any coherent European energy foreign policy with one voice (CER, 2011: 3). The European Council, on 4th February 2011, concluded that there is a need for better coordination and solidarity within the EU members, by European Commission and Gas Coordination Group monitoring, regarding the external energy relations with key producers, transit, and consumer countries (European Commission, COM (2011) 540 final, 2011: 1–2), while the Commission estimates that around 60 intergovernmental gas agreements may exist between member states and third parties (CER, 2011: 3).

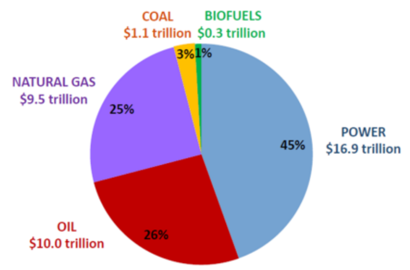
Sascha Muller–Kraenner argued (2007: 78) that the EU should find appropriate answers to the following questions with regard to the future energy challenges:

4. How to structure the relations with Russia?
5. Will Iran successfully be integrated into the international system and global economy?
6. Is Turkey to become a member of the EU?

The European Commission and the Gas Coordination Group monitor external energy relations with key producers, transit, and consumer countries, while the European Commission estimates that around 60 intergovernmental gas agreements might exist between the EU member states and the third parties (European Commission, COM (2011) 540 final, 2011: 1–3).

So, moving beyond the Lisbon Strategy by more insistence on "the core common values" in the EU–27 is vital (Schweiger, 2009: 534), while energy, in general, and natural gas and LNG, in particular, is a shared concern.

Figure 29: The required investment in energy infrastructure worldwide, 2011–2035



Source: World Energy Outlook, 2011

Fourth, further and adequate investment in natural gas and LNG industries and infrastructures in consumers, transit countries and producers (Eurogas, "Long– Term Outlook to 2030": 6; W.C. Ramsay, 2008) would be vital. For this reason, diversification of LNG routes and suppliers is expensive (Pascual & Zambetakis, 2010: 21).

According to the WEO–2011, roughly $38 trillion of investment is required to meet global projected energy demands by 2035 and the share of natural gas is $9.5 trillion (figure 29).

The EU Commissioner for Energy argued that the Union requires at least €1 trillion of investment in its various energy sectors over the next 20 years, such as the construction of new import pipelines and LNG facilities, renewable energy sources technologies and also energy efficiency (Oettinger, 27th October 2011: 3; Oettinger, 2010: 2–5).

Stern (2002) and Arianna Checchi alongside his colleagues (2009: 16) believed that the "investment and facility, exporters' reliability, as well as transit risks" will threaten the EU's security of supply in the future.

However, the on–going economic crisis within the EU and also "the Eurozone governments' failure to coordinate their economic policies" could possibly push further countries into crisis in the future (Schweiger, 2008), similar to what has happened in some Southern EU member states, e.g. Greece, Spain and Italy.

2.9. The four EU's Case Studies regarding the natural gas and LNG

As analysed in this chapter regarding the increase of LNG demand in the EU in the future, having started over recent years, there are 31 LNG terminals in the EU, either in existence, under construction, or under consideration, except cancelled and suspended ones, 24 of which, close to 80% of these facilities, are situated in the UK, France, Spain and Italy. The third latest countries are the 4th, 5th, and 6th global LNG importers and Italy is the 12th one (figure 40). On the one hand these countries will be faced with growing LNG demands, and, on the other, the states mentioned are the main LNG entrances for the future single and integrated EU's gas market, so their energy policy will have an effect on regional imports.

2.9.1. The UK as the first Case Study

2.9.1.1. Geo–politics of the UK

The UK, located off the north–western coast of continental Europe, consists of England, Wales, Scotland and Northern Ireland, so the latter is the only part of the UK that shares a land border with another EU country–the Republic of Ireland. Apart from this border line, the UK is surrounded by the Atlantic Ocean, the North Sea, the Irish Sea and the English Channel, connecting Britain to France, as the second closest country to the UK (IEA the UK Review 2006: 23). Notwithstanding being a major member of the EU, the UK is not part of the euro–zone.

2.9.1.2. The UK's energy policy and energy security

The Department of Trade and Industry (DTI) has the primary responsibility for the development and implementation of UK's energy policy on the supply side (IEA the UK Review, 2006: 31) and the National Grid Gas is responsible for preparing the required data regarding the security of gas supply in this country, which is published jointly by Department of Energy and Climate Change (DECC).

The latter also develops a Strategy and Policy Statement for Office of Gas and Electricity Markets (Ofgem), which reflects the British energy security policy objectives. The Ofgem is the regulator for electricity and natural gas with close relationships with industry in order to carry out more projects regarding gas security (UK Department of Energy & Climate Change 2011: 7&9).

In July 2001, the DTI and Ofgem set up the Joint Energy Security of Supply (JESS) working group to assess the UK's gas supply risks in the future with the aim of monitoring the scale of gas and electricity supplies and the availability of at least seven years of supply in advance (IEA, the UK Review 2006: 32).

The significance of the energy supply has been highlighted in the UK's first ever National Security Strategy, published in March 2008 and was followed by a comprehensive update in June 2009 (www.cabinetoffice.gov.uk/reports/national_security) and also in the government's National Policy Statements for energy development (www.decc.gov.uk) with the aim of energy developments.

Malcolm Wicks, the member of parliament and the Special Representative for the UK Prime Minister, argues that "the UK's energy security is ensured by stability of gas supply with reasonable price, diversification of suppliers and energy mix, whereas this country should retain independence in its foreign policy avoiding dependence on a particular supplier" (Wicks, 2009: 97–99). The UK must consider whether the part of its energy policy ceded to the EU, would be in its national interest (Wicks, 2009: 90).

So, according to the UK's Energy White Paper on 9th July 2003, the four key energy objectives include:

- ✓ To reduce the UK's greenhouse gases by 60% before 2050, with real progress by 2020, based on the 20/20/20 by 2020 policy;
- ✓ To maintain the reliability of supply with diversifying of energy sources and routes;
- ✓ To promote liberalised and competitive energy market in the UK and the rate of sustainability;

- ✓ To ensure adequate energy with affordable price (IEA, the UK Review 2006: 165).

The DECC in its annual energy statement on 23rd November 2011 insisted on a new energy portfolio based on "securing supply with affordable price toward a low–carbon energy".

So, according to the report by the Economic Policy Centre (EPC) in London issued in December 2009 entitled, "Securing Our Energy Future: Why and How It Must Be Done," without certain access to energy, there can be no economic activity in the UK, and unless the price of access is low enough, economic activity will be limited.

The UK in line with the EU's energy policy, like integrated and competitive energy markets, has taken some important steps, such as opening its gas markets to competition or "freedom of access" (R. Odell, 2002: 606) since 1984 (EIA, International Energy Outlook 2011: 46). Hence gas market liberalisation has started in this country earlier than other continental countries, while this country tried to be a gas trading hub within the EU, such as Henry Hub in the US (Roze, 2007: 19), while the oldest European notional hub, the so–called National Balancing Point (NBP) was established in the UK in 1996.

The UK, moreover, was the first country to announce a 60% greenhouse gases reduction by 2050 (IEA, the UK Review 2006: 9) and the Energy Saving Trust (EST) and the Carbon Trust (CT), as the two independent bodies funded by the government, promote the reduction in greenhouse gases and the rise of renewable energy sources in this country (IEA, the UK Review 2006:31).

2.9.1.3. Geo–politics of natural gas and pipelines in the UK

Since the 1970's, the UK has developed its off–shore gas fields, chiefly in three distinct areas, comprising: associated fields on the UK Continental Shelf (UKCS), non–associated fields in the Shearwater–Elgin area of the Southern Gas Basin, including Elgin, Franklin, Halley, Scoter, and Shearwater (http://www.eia.gov/UK), located adjacent to the Dutch sector of the North Sea, and also non-associated fields in the Irish Sea (IEA 2010, the UK: 15). According to Oil and Gas Journal, the UK's proven natural gas reserves declined 12% in 2011, compared to the previous year.

There are four main internal pipeline systems in the UK that carry gas from off–shore platforms to coastal terminals. The Shearwater–Elgin Line (SEAL), operated by British Shell (http://www.eia.gov/UK), transports gas from the Shearwater–Elgin area to the landing terminal at Bacton, England. ExxonMobil operates the 200–mile Scottish Area Gas Evacuation (SAGE), which transports associated gas from UKCS fields to the landing terminal at St. Fergus, in Scotland. The 250–mile Central Area Transmission System (CATS), operated by the British BP (http://www.eia.gov/UK), links fields in the Central North Sea to Teesside. Finally, Shell operates the 283–mile Far North Liquids and Gas System (FLAGS) linking associated gas deposits in the Brent oil system with St. Fergus.

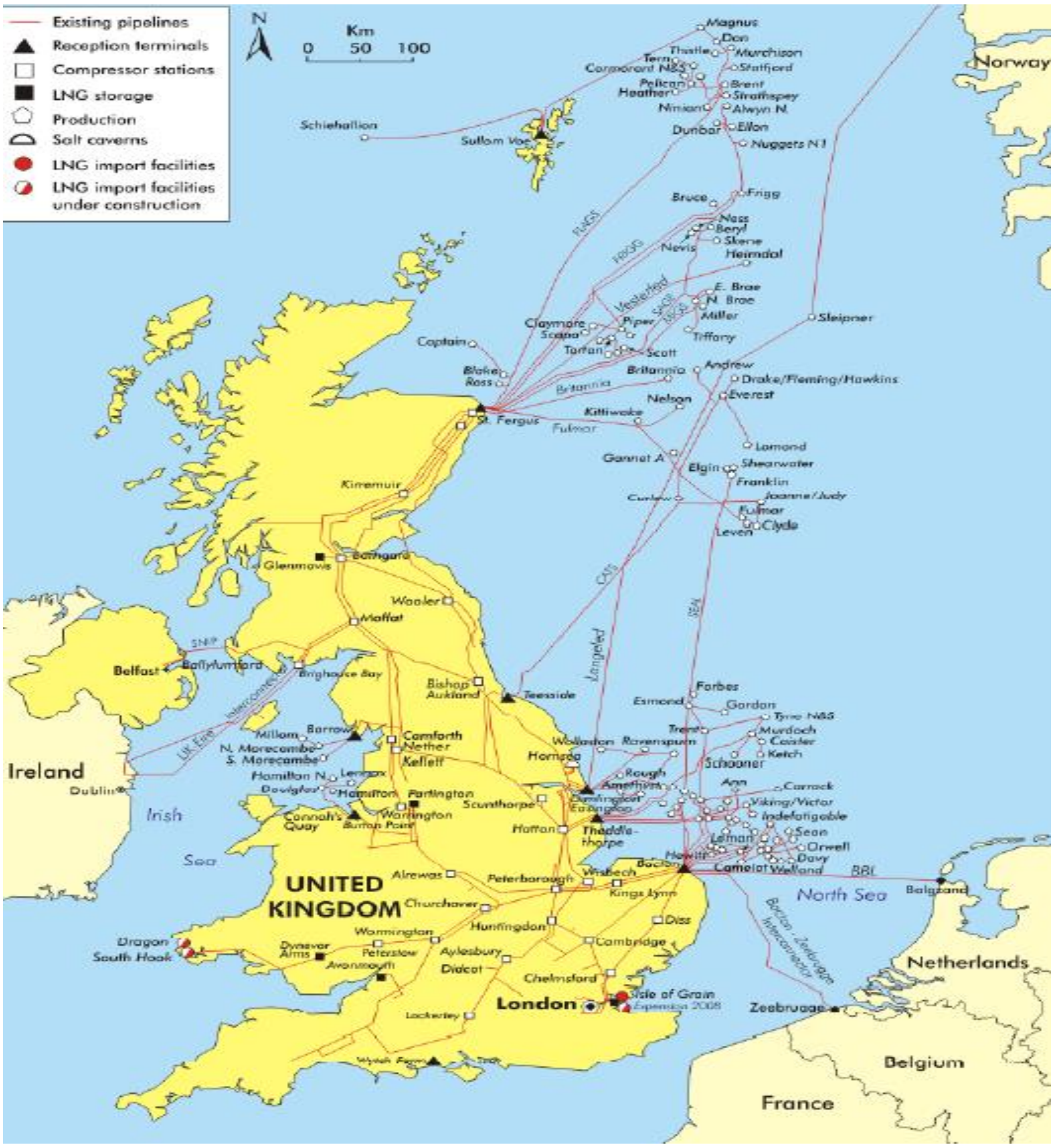
Once brought on–shore, the responsibility for transporting natural gas throughout the UK belongs mostly to the National Grid and privately–controlled Scotia Gas Networks, an offshoot of the state–owned British Gas (IEA 2010, the UK: 16).

The UK's gas network is connected internationally with continental suppliers (IEA 2010, the UK: 16). The Interconnector pipeline connects the Bacton terminal with Zeebrugge, Belgium in order to export both natural gas from the UK to continental Europe and import into the country, if required, whereas the Moffat Interconnector, operated by Gaslink, links the UK with the Republic of Ireland, running from Moffat in Scotland (DECC 2011: 18). Norway's North Sea natural gas fields, via the Langeled (23.5 bcm in 2009) and the Frigg pipelines, operated by Total, as well as the Netherlands through the Bacton–Balgzand pipeline or BBL (6.5 bcm in 2009) are more interconnectors, connecting with the UK territory (map 2).

In late 2007, the UK's South–North gas pipeline was completed with the purpose of transferring natural gas from the Republic of Ireland to Northern Ireland (IEA 2010, the UK: 16–18).

In additional, some more continental interconnector pipelines are planned or under construction (EIA World Outlook 2011: 46).

Map 2: The UK's natural gas and LNG infrastructures



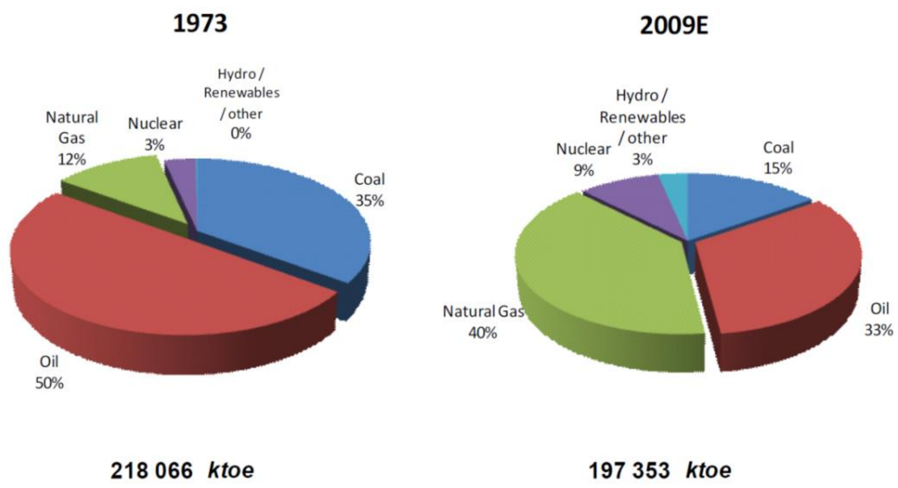
Source: IEA 2010, the UK: Oil and Gas Security Emergency Response of IEA Countries: 17

The exploitation of gas from the Continental Shelf in the North Sea and Southern Gas Basin led to an expansion in the gas consumption in the UK, particularly in the 1990s, by constructing more gas–fired electricity generation plants, increasing the percentage of the total electricity produced by gas to 44% in 2009 (IEA 2010, the UK: 4) replacing coal in the power system and this transition has been accelerated by the goal of cutting greenhouse gases, while nuclear power capacity has stabilised (Eurostat Statistical Book, 2009: 98).

2.9.1.4. Total primary energy sources demand and production, past, now and the future

The UK's total primary energy sources has dropped from over 218 ktoe in 1973 to a bit more than 197 mtoe in 2009, while the shares of oil and coal have declined considerably, unlike the gas share, rising from 12% of total primary energy sources to 40% (figure 30) during the same period (IEA 2010, the UK: 4).

Figure 30: The UK's total primary energy sources, 1973–2009



Source: IEA 2010, the UK: Oil and Gas Security Emergency Response of IEA Countries: 4

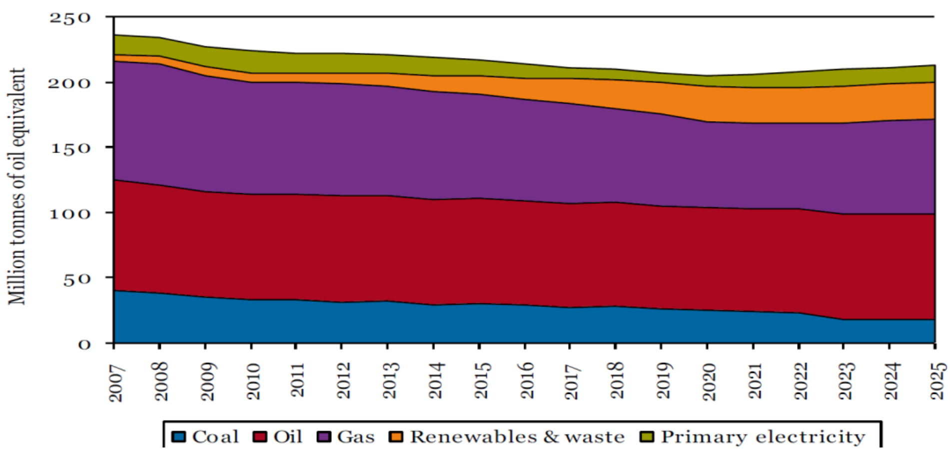
The high–cost wind plant(CER, 2011: 18) is the major renewable energy source for power generation in the UK by 2020, followed by tidal, and biomass (Eurostat Statistical Book, 2010: 98), but according to Prof. Phil Taylor, Deputy Director for Durham Energy Institute, at the "Smarter Energy–Will it cost the Earth?" Conference, which took place on 6th September 2011, in order to increase renewable energy sources share in the UK's energy mix, nearly £30 bn needs to be invested on renewable energy sources by 2030. Some experts in this panel believe that unskilled workforce, lack of enough high–tech facilities and expertise, huge investment and inadequate energy efficiency are the main challenges the UK faces in order to achieve the decarbonisation targets by 2050.

The DECC in its annual energy statement, issued on 23rd November 2011 estimated that the cost of this venture by 2020 would be around £14 bn.

Currently, there are 10 nuclear power plants that are online in the UK. Nonetheless, the lifetime of eight of these will end by 2023, but the government identified some potential sites in 2009 for building new plants by 2025 (http://www.eia.gov/countries/UK).

Wicks (2009) warned that the UK will probably lose 30% of its generating capacity from coal and nuclear energy by 2021 as these plants close down (Cole, 2010). Switching from coal to gas in the UK, has been more economical and environmentally–friendly, while the real loser from this change has been coal (figure 31), rather than oil (Kandiyoti, 2008: 38), so imported hydrocarbons could still account for more than 90% of UK's energy consumption by 2020 (Sascha Muller–Kraenner argued 2007: 81) (figure 31) and even up to 60% of it in 2050, according to the previous UK's Secretary of State for Energy and Climate Change, between 2005 to 2008 (Wicks, 2009: 57).

Figure 31: The UK's current and projected demand for primary energy



Source: Wicks, 2009: 56

While the country's gas demand grew by roughly 70% from 1990 to 2008, the British gas production peaked in 2000 at around 115 bcm, and has steadily declined, standing at slightly more than 62 bcm in 2009. As a result, this country, as a net natural gas importer (IEA 2010, the UK: 3) had to import more than 31% of its gas needs in 2009 (table 4).

Table 4: The UK's key natural gas data

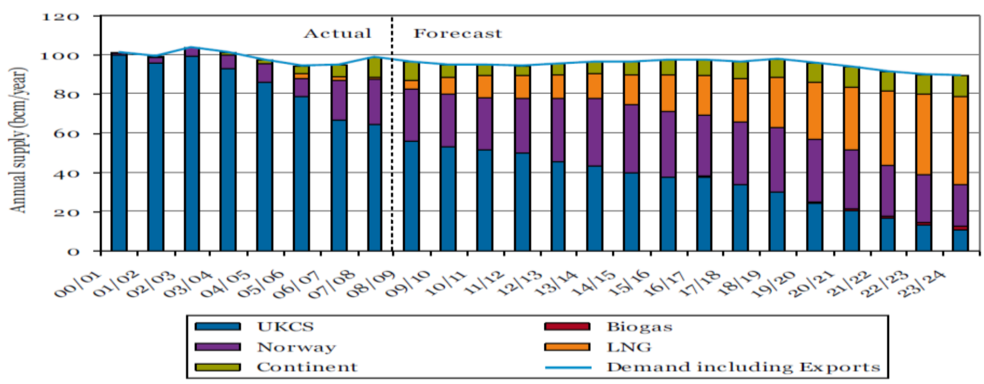
	1985	1990	1995	2000	2005	2007	2008	2009 *
Production (mcm/y)	43 104	49 672	75 539	115 386	92 805	76 074	73 540	62 125
Demand (mcm/y)	56 373	58 313	75 179	101 812	99 643	95 949	99 020	90 495
Transformation	*921*	*1 374*	*13 780*	*31 641*	*31 803*	*33 993*	*36 070*	-
Industry	*15 839*	*14 754*	*15 073*	*17 831*	*14 572*	*13 198*	*12 873*	-
Residential	*26 478*	*28 678*	*29 883*	*33 451*	*34 745*	*31 971*	*32 982*	-
Others	*13 135*	*13 507*	*16 443*	*18 889*	*18 523*	*16 787*	*17 095*	-
Net imports (mcm/y)	13 269	8 641	- 360	- 13 574	6 838	19 875	25 480	28 370
Import dependency	*23.5%*	*14.8%*	*-0.5%*	*-13.3%*	*6.9%*	*20.7%*	*25.7%*	*31.3%*
Natural Gas in TPES	*23.2%*	*23.0%*	*30.3%*	*39.4%*	*38.6%*	*39.1%*	*40.7%*	*39.5%*

Source: IEA 2010, the UK: Oil and Gas Security Emergency Response of IEA Countries: 2

It is envisaged that the gas consumption will fall by between 14% to 27% by 2020, however domestic production will drop over the same period as well, meaning that the UK's import dependency will increase (IEA 2010, the UK: 15–16).

Based on figure 32, National Grid's projection shows that the UK domestic gas production, peaked in 2000, and is projected to decline to 26 bcm in 2020 (DECC 2011: 14) or around 24 bcm, according to the IEA, the UK (2010: 15) and the UK's LNG import might be equal to Japan, the current global leading LNG importer, by 2020 (Hartley & B.Medlock, 2006: 357–407), that is because the current British Prime Minister's special representative for international energy believes that "the LNG is a vital part of the UK gas supply and will become more significant" (Wicks, 2009: 98).

Figure 32: The UK's annual gas supply forecast, 2000–2024



Source: Wicks, 2009: 67

On the basis of the National Grid's statistics, the UK might import 50–70% of its gas needs by then (figure 32), but the percentage of renewable energy sources in the energy mix impacts on the amount of gas imports. Table 7 shows that the EU's renewable energy sources target for the UK is the increase of its share in primary energy sources from 1.3% in 2005 and 3% in 2009 to 15% by 2020, the most increase among the EU's member states, so if this country is unable to achieve this goal, the scale of natural gas imports would rise much further, according to the IEA, the UK (2010: 16).

2.9.1.5. The UK, as the leading LNG importer?

The UK was the first LNG importer in Europe in 1959 and until the mid–1990s, Algeria was the only exporter to this country. Currently, the UK has four LNG import terminals, with the largest of Europe's LNG terminals in South Hook near to the Dragon terminal, and the country was the eighth–largest importer of LNG in 2010, according to IEA (Key World Energy Statistics 2011: 13) with 37 bcm/y imports, while the existing LNG capacity within the British terminals is more than 39 bcm/y, that could be increased by more than 20–27 bcm/y in the future (table 5).

Ledesma in an interview on 16th February 2012, insisted that the UK needs to import LNG to meet its increasing demand requirements (figure 32) in the coming years and also transport inside the EU, depending on the level of gas demand which will be impacted by economic situations.

Table 5: The UK's existing LNG terminals and those under construction and consideration

LNG Terminal	Start–up	Capacity	Shareholders	Source
Isle of Grain Ltd	Phase 1: 2005 Phase 2: 2008 Phase 3: 2010	4.6 bcm/y 6.5 bcm/y 5.2 bcm/y	National Grid (100%)	Algeria (20 years) & Other sources expected
Dragon Ltd (Milford Haven II)	2009	4.4 bcm/y	Petroplus (20%) BG Group (50%) Petronas (30%)	Egypt & Trinidad and Tobago
South Hook Ltd Co.(Milford Haven I)	Phase 1: 2009 Phase 2: 2010	7.8 bcm/y 7.8 bcm/y	ExxonMobil (30%) Qatar Petroleum(70%)	Qatar
Canvey Island Co.	Suspended	5.4 bcm/y	Centrica, LNG Japan, Calor Gas & Osaka Gas	Not clear
Teesside Off–shore Gas Port	2007	3 bcm/y	Excelerate Energy	
Anglesey Am wich Off–shore	Unknown (p)	13 bcm/y	Canatxx	Not clear
Port Meridian	2014 (p)	8 bcm/y	Hoegh LNG	Not clear

Sources: by the Author on the basis of: the Energy Delta Institute, GLE LNG map 2011, NG Information OECD/IEA 2011, International Gas Union (IGU) World LNG Report 2010, King & Spalding 2006, The California Energy Commission (Western Europe LNG Map, July 2010), globallnginfo.com, May 2012.

Qatar has become the main LNG supplier to the UK since 2011, followed by Algeria, with the remaining volumes arriving from Egypt, Peru, and Trinidad and Tobago (table 5), though a tanker carrying the first–ever shipment of LNG from the US to the UK arrived on the British shores in November 2010 (www.eia.gov/countries/the UK). Matthew Hulbert (annex 1) in an interview on 15th May 2012 argued that the UK will use LNG from Persian Gulf, especially Qatar, to a greater extent compared to Italy and Spain, the other two main LNG importers within the EU in years to come.

On the other hand, the UK is amongst the signatories of the Extractive Industries Transparency Initiative (EITI) insisting on pushing the Middle Eastern countries, especially gas suppliers, towards the political reform and human rights (Young, 2009: 68).

The main natural gas and LNG suppliers to the UK under the long–term/take–or–pay contracts will be Qatar, Norway and Algeria up to 2025, dropping from

31.4 bcm/y in 2011 to 15.3 bcm/y in 2026 (table 6), according to the most recent Wood Mackenzie European Gas and Power Service report, published in an addendum to the Statutory Security Report 2011, London in November (p.20). However, unlike the declining of indigenous production, the UK's natural gas and LNG demands will increase (figure 32), depending on the share of the renewable energy sources in total primary energy sources (figure 31).

Table 6: The UK's long–term natural gas and LNG contracts with suppliers

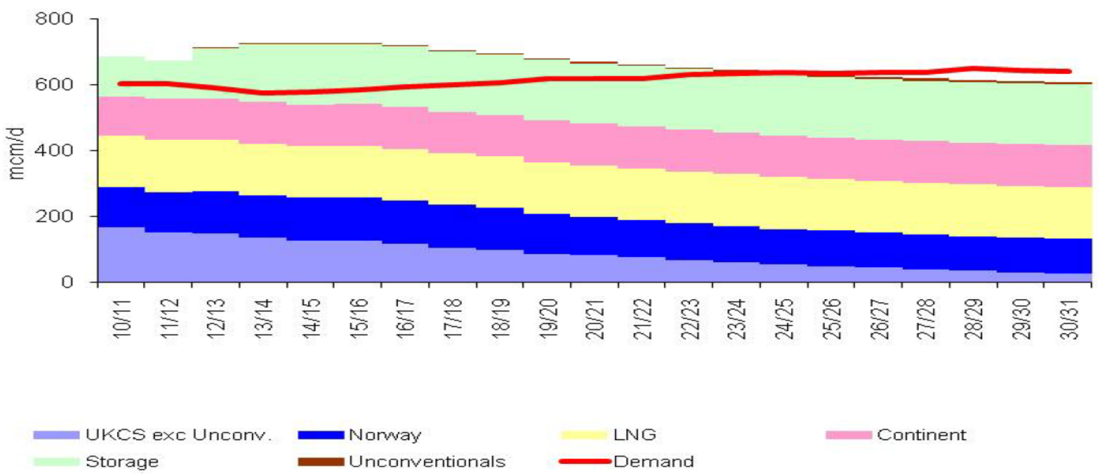
Bcm	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Algeria	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08
Egypt	1.38	1.38	0.95	0.76	0.93	2.03	0.00	0.00	0.00	0.00
Equatorial Guinea	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68
Norway	9.33	8.68	8.68	8.68	6.47	1.93	1.79	1.43	1.43	1.29
Norway Assumed Extension	0.00	0.00	0.00	0.00	1.50	5.11	5.11	5.11	5.11	5.11
Peru	1.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Qatar	14.69	16.34	16.34	15.44	14.97	14.97	14.97	14.97	14.97	14.97
Total Contracted ACQ	**31.4**	**31.2**	**30.7**	**29.6**	**28.6**	**28.8**	**26.6**	**26.3**	**26.3**	**26.1**
Total Contracted Take or Pay	**16.9**	**16.0**	**16.0**	**15.5**	**14.7**	**13.8**	**13.7**	**13.4**	**13.4**	**13.2**
Bcm	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Algeria	3.08	3.08	3.08	3.08	3.08	0.00	0.00	0.00	0.00	0.00
Egypt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Equatorial Guinea	1.68	1.68	1.68	0.95	0.00	0.00	0.00	0.00	0.00	0.00
Norway	0.93	0.76	0.33	0.33	0.33	0.33	0.00	0.00	0.00	0.00
Norway Assumed Extension	5.11	5.11	5.11	5.11	3.61	0.00	0.00	0.00	0.00	0.00
Peru	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Qatar	14.97	14.97	14.97	14.97	14.97	14.97	14.97	14.97	14.97	14.97
Total Contracted ACQ	**25.8**	**25.6**	**25.2**	**24.4**	**22.0**	**15.3**	**15.0**	**15.0**	**15.0**	**15.0**
Total Contracted Take or Pay	**12.9**	**12.8**	**12.4**	**12.4**	**11.0**	**7.8**	**7.5**	**7.5**	**7.5**	**7.5**

Source: Wood Mackenzie, published in an addendum to the Statutory Security Report 2011, London, November: 20

Ofgem and the DECC issued information regarding the long–term natural gas and LNG contracts with third–party suppliers in August 2011 and the DECC sent this data to the Commission, based on the EU Regulations, particularly Directive 2004/67/European Commission.

The National Grid's recent projections, published in an addendum to the Statutory Security Report in November 2011 in London (p.17), announced that the UK must meet its peak gas demand in the future as well, such as in a severe winter as with the cold weather in January 2010, having reached up to roughly 600 mcm/d in 2010–2011, whereas the peak of LNG demand in this country is roughly 170 mcm/d and this trend moves on up to 2030 with some fluctuation (figure 33), depending on the scale of renewable energy sources share in this country's energy mix. The National Grid, moreover, argued that the availability of natural gasand LNG would be important not only for the UK but also for the whole EU at peak times, while any unpredictable events, like the Russia–Ukraine gas dispute in January 2009 and also technical problems, such as on the Langeled pipeline from Norway, could critically threaten the EU's gas market, especially in times of peak demand (IEA 2010, the UK: 18).

Figure 33: The UK's peak daily winter gas demand, 2010–2030



Source: The UK's National Grid, published in an addendum to the Statutory Security Report 2011, London, November: 17

The UK, moreover, prepared a report concerning the assessment of security of natural gas and LNG supply, in November 2011, on the basis of Article 9 of the EU Regulation No 994/2010 adopted by the European Parliament and the Council of 20th October 2010 regarding the required measures to safeguard security of supply, so the results of this assessment should be raised in two places; "The Preventive Action Plan" and "Emergency Plan" are set to be adopted and made public by December 2012 (DECC 2011: 5).

According to this report, the UK seem to have resilience in its natural gas and LNG market in the short term, however, this country will face some challenges in the medium to long term, as the gas demand from the power generation sector is to increase, whereas the gas–fuelled plants replace coal–fired electricity ones (Davidson, 2012).

Consequently, the Energy Act 2011 was enacted by the British Parliament, in order to respond to this country's security of supply challenges, enabling Ofgem to deal with the commercial incentives aims to ensure sufficient natural gas and LNG supply to meet the future gas demand (DECC 2011: 37), and with affordable pricing. So, the DECC in its annual energy statement, issued on 23rd November 2011 insisted on the growing increase of NG in the UK's energy mix in the future, necessitating new natural gas and LNG plants. However, the global and consequently the British gas price will rise by 2020.

Howard Rogers (annex 1) in an interview on 14th March 2012, argued that a competitive gas market which aims to receive the least expensive natural gas and LNG is the vital objective for the coming EU's single market, so the Persian Gulf "with the relatively shallow water location of the huge South Pars and North could provide the significant volumes of LNG, in addition to the existing Qatar's LNG supply, toward the EU and also the UK in coming years with a lower cost base, which would be a main competing source of new LNG, compared with other suppliers". Therefore, establishment of the British "Middle East Energy Group" could be assessed on this basis (Young, 2009: 66).

There are some plans to explore for unconventional gas, slightly commercially during the 2020s (figure 33), such as shale gas in the UK, e.g. in Lancashire (Oil & Energy Trends, 17th September 2010: 8). However, the House of Commons' Energy and Climate Change Select Committee called for an investigation into the link between shale gas drilling tests in north–west England and two earthquakes which occurred in the area shortly after the start of operations, which led to the suspension of this activity in the UK and the Netherlands (Platts 4th July 2011: 15).

The National Grid also suggests that the UK should increase its own natural gas and LNG import capacity to around 193 bcm/y up to 2020 and the LNG import capacity should reach roughly 60 bcm/y by the end of the current decade (DECC 2011: 16) and this volume of imports will probably peak by 2030. Hence, it means if the other British LNG projects subsequently materialized, then final capacity will increase to approximately 60 bcm/y.

2.9.2. Italy as the second Case Study

2.9.2.1. Geo–politics of Italy

The Republic of Italy, as the boot–shaped peninsula, is located in south–central Europe, bordered by Switzerland, France, Austria and Slovenia to the north along the Alps with Sicily and Sardinia, the two largest islands in the Mediterranean Sea along some other smaller islands (map 3).

2.9.2.2. Italy's energy policy and energy security

Since the modification of the Italian Constitution in 2001, energy policy has been partially handed over to the regions and autonomous provinces; nevertheless, the central Government is responsible for the general framework (Cortinovis et al. 2011: 5).

Based on "The New National Energy Strategy", entitled Law no. 99/2009 approved by the by Ministry of Economic Development (Ministero dello Sviluppo Economico or MSE) in 2009, Italy pursued some targets in its energy policy outlook aiming to ensure greater reliability of the energy security in the future, comprising: diversification of energy resources and suppliers, promotion of renewable energy sources and energy efficiency, improvement of energy competitiveness and development of its energy infrastructures appropriately in line with the common European internal market (Energy Policies of IEA countries, Italy, Review 2009: 19–27), while the process of opening the gas market has been on–going since 2003 (Eurostat Statistical Book, ISSN 1831–3256, 2009: 55).

2.9.2.3. Geo–politics of natural gas in Italy

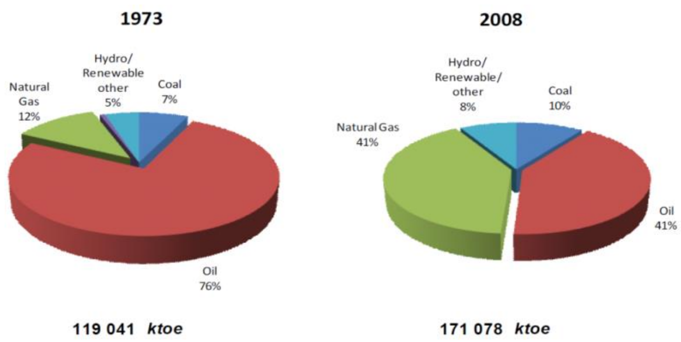
Around two–thirds of Italy's gas reserves are located off–shore (IEA 2010, Italy: 12) and for the first time in Europe, natural gas was discovered in the Italian Po Valley by Agip Co. during the Second World War, and also gas activities grew more by ENI. The Hydrocarbon National Company established in 1953, converted this country to the gas hub within south–west Europe becoming the biggest gas consumer and producer in 1965 (H. Hayes, 2006: 49–91), until huge reserves were extracted in the North Sea and Groningen in the Netherlands (Barnes et al. 2006: 3–27).

2.9.2.4. Total primary energy sources demand and production, past, now and the future

Oil and gas have dominated in Italy's total primary energy sources by 82–88% during the past three decades, while, unlike coal, the share of renewable energy sources, like wind, solar and biogas powers, as well as, to come extent, hydroelectric plants, according to the EU's RE–SHAPING study (Cortinovis et al. 2011: 11) which increased from 5% in 1973 to 5.2% in 2005 and 8% in 2008 (table 1 & figure 34) and should reach the ambitious (Poletti & D'Orazio, 2009: 4&15) 17% of the EU's renewable energy sources target by 2020, based on the European Commission's Green Package in January 2008. However, the country faces some constraints regarding the effective rise of renewable energies in its energy mix in the future (IEA 2010, Italy: 4).

Italy needs approximately €5 bn up to 2013 in order to reach its non–hydrocarbon targets by then (Cortinovis et al. 2011: 11), so the deployment of renewable energy sources has been slow, despite the numerous support schemes implemented since the beginning of the 1990s in Italy (Poletti & D'Orazio, 2009: 5), but according to the European Commission "European Energy and Transport Trends To 2030–Update 2007", published on 8th April 2008 by the Directorate–General for Energy and Transport, this share would reach 8.2–9.3% by 2020, far below the 17% target.

Figure 34: Italy's total primary energy sources, 1973–2007



Source: IEA, Italy 2010: 4

Italy's total primary energy sources in 2008 was more than 171 mtoe, an increase of more than 40% compared to 1973 (table 7 & figure 34) with the big jump in natural gas share in its energy basket and the energy mix is expected to grow to 232 Mtoe by 2030, nearly 35% up from 2008 (IEA 2010, Italy: 4).

The European Regional Development Fund (ERDF) plays an important role to support regional members, like Italy, in order to employ more renewable energy sources in their own total primary energy sources by helping to develop industrial activities linked to renewable energies, tackle local needs and support public investment, so, 7% of the ERDF resources are assigned to Italy in this respect (Cortinovis et al. 2011: 3 & 4).

Improving energy efficiency, based on the Italian Energy Efficiency Action Plan, adopted by MSE on July 2007 under the EU's Energy End–Use Efficiency and Energy Services Directive 2006/32/European Commission, has been in place, too (Poletti & D'Orazio, 2009: 13).

After the incident in Fukushima and the increased opposition to nuclear energy, the government set aside its plans on nuclear plants and decided to retain "Conto Energia", the scheme providing support to energy producers using PV and solar thermal systems (Cortinovis et al. 2011: 11).

Dr. Nicolo Sartori (annex 1) in an interview in May 2012 argued that in spite of the renewable energies rising in Italy in recent years, particularly after the so–called "Bersani Decree" in 1999 and continuity of this process in the future on the basis of the 2010 Italian Renewable Energy Action Plan, as well as the public opinion's opposition towards the nuclear power confirmed by the results of the 12th and 13th June 2011 referendum, dependence on natural gas is even clearer in the Italian case and its role in the years to come.

According to IEA 2010, Italy is the largest gas market in Europe behind the UK and Germany (Energy Policies of IEA countries, Italy, Review 2009: 99), while its gas demand has grown by close to 350% between 1973 to 2008 (figure 34) because of the increasing use of gas in power generation and the reduction of oil's share in total primary energy sources (IEA, Italy 2010: 3) from 76% of energy mix in 1973 to 41% in 2008, on the basis of the national programme to alleviate Italian dependence on oil imports (IEA, Italy 2010: 12).

Italy's domestic gas production is very limited that in 2010 it amounted to around 8 bcm or 6.6 Mtoe (IEA 2010, Italy: 12) less than 10% of total consumption (table 7), whereas the statistics peaked in 1995 by more than 20 bcm/y during the nearly recent three decades.

Table 7: Italian key natural gas data

	1985	1990	1995	2000	2005	2007	2008	2009 *
Production (mcm/y)	14 245	17 296	20 384	16 633	12 071	9 706	9 255	8 119
Demand (mcm/y)	32 592	47 405	54 385	70 745	86 265	84 897	84 883	78 126
Transformation	*6 133*	*10 033*	*11 645*	*22 819*	*32 842*	*34 293*	*37 821*	-
Industry	*11 848*	*17 778*	*19 191*	*21 492*	*19 693*	*20 102*	*14 647*	-
Residential	*14 000*	*13 731*	*16 421*	*18 280*	*22 942*	*19 509*	*19 555*	-
Others	*611*	*5 863*	*7 128*	*8 154*	*10 788*	*10 993*	*12 860*	-
Net imports (mcm/y)	18 347	30 109	34 001	54 112	74 194	75 191	75 628	70 007
Import dependency	*56.3%*	*63.5%*	*62.5%*	*76.5%*	*86.0%*	*88.6%*	*89.1%*	*89.6%*
Natural Gas in TPES	*21.4%*	*27.2%*	*28.6%*	*34.5%*	*39.3%*	*39.7%*	*40.3%*	*40.2%*

Source: IEA, Italy 2010: 2

Import dependency on gas in Italy is very high, standing at around 90% in 2009 and is set to increase to over 95% by the 2030s (IEA 2010, Italy: 12) turning Italy in 2011, according to IEA, Key World Energy Statistics (2011: 13) in to the third gas importer in the world after Japan and Germany with 75 bcm.

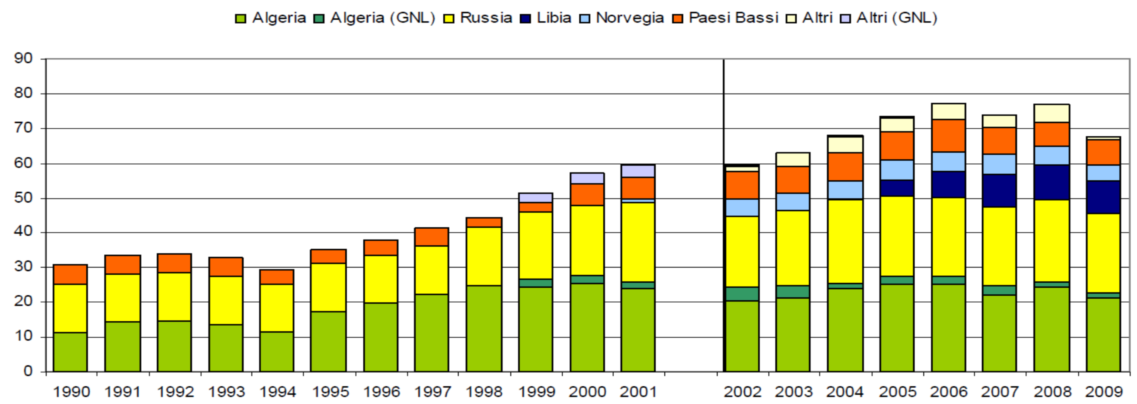
2.9.2.5. The Italy's gas pipelines and LNG projects

Almost 88% of Italy's gas imports are being accomplished via pipeline mostly originating from Algeria, Russia, Libya (figure 35). The four main gas import routes exist in Italy, these being the EU Corridor (which includes the Netherlands and the UK), the Northern Corridor (Norway), the Eastern Corridor (Russia) and the Mediterranean Corridor (Algeria and Libya (IEA 2010, Italy: 12). Since the year 2000, Italy has imported natural gas via the Green stream pipeline from Libya (8 bcm/y), development of the TAG pipeline from Russia (6.4–9.7 bmc/y), the Transmed and Galsi pipelines (6.5–12 bmc/y) from Algeria (map 3) (Poletti & D'Orazio, 2009: 23). Nevertheless, the main TPMC and TAG pipeline interconnections are via Mazara and Tarvisio.

Italy's LNG imports have exceeded 9 bcm/y (table 8), roughly 12% of the country's gas demand, either by the North Adriatic Sea off–shore terminal near Rovigo, inaugurated in 2009, or Panigaglia in Liguria.

For the time being, Italy is the key EU entry point for North African gas supplies from Algeria and Libya and has decided to enhance its position in the future by new corridor and LNG terminals (Sartori, 2011). For this reason, the share of Russian gas in Italy's gas market decreased by almost 26% compared to 2009, while the shares of Algeria have increased by 22% and the shares of Qatar almost tripled, on the basis of the Natural Gas Information, OECD/IEA, 2011.

Figure 35: Italy's natural gas imports by source 1990–2009 (bcm)



Source: Carnevalini, Rosita (2010), "Case study: storage in Italy", Florence School of Regulation, March 25th: 7

2.9.2.6. The Italian LNG projects for the future

The Italian Government has developed its gas trade, including the LNG regasification terminals, with considerable investment in recent years on infrastructure, while deciding to increase the current import capacity in two online Panigaglia (La Spezia) and Rovigo–North Adriatic (Isola Di Porto Levante) facilities with more than 9 bcm/y in the future from new terminals both under construction and under consideration (table 8), the most in the EU (Energy Policies of IEA countries, Italy, Review 2009: 101).

Map 3: Italy's natural gas and LNG infrastructures

Source: IEA 2010, Italy: 14

The majority of these facilities will be installed off–shore, as building on–shore LNG terminals in Italy has caused certain local opposition (Energy Policies of IEA countries, Italy, Review 2009: 116). However, Rome has decided to raise its profile as the natural gas and LNG hub in the EU, with the most LNG terminals under consideration within the Union, particularly with a view to more imports from the Mediterranean basin and the Middle East/Persian Gulf (Eurostat Statistical Book, ISSN 1831–3256, 2009: 54), while attempting to increase the competition between the current and future gas suppliers, particularly from the South Gas Corridor.

Hulbert (interview, 2012) believes that this corridor would be important not only for Italy but also the EU's natural gas and LNG imports and diversification, linking the Italian gas system to ultra–regional suppliers and then connecting to the EU single market in the future (Energy Policies of IEA countries, Italy, Review 2009: 114).

Sartori (interview, 2012), furthermore, pointed to the Commission communication to the European Council and Parliaments, having emphasised that the Union should import roughly 10–20% of its required natural gas and LNG, equivalent roughly to 45–90 bcm/y, via the Southern Gas Corridor by 2020, but he added that Rome sponsors the ITGI (alongside France) and also supports the 900–km off–shore pipeline South Stream from Russia, notwithstanding the European Commission's displeasure.

Italy is among the European states, like Austria and Switzerland, most interested in gas imports from the Middle East/Persian Gulf, such as Iran, according to Clément Therme in an interview (2012) on 25th May 2012. He argued that Italy is the part of the EU's states that have energy cooperation with Iran and Qatar, within the Persian Gulf, such as its support of the TAP project in partnership with Swiss EGL, while the Italian ENI is present in Iranian hydrocarbon industries (especially in production phases 4 and 5 of the South Pars). The Edison was also in negotiations for gas exports into Italy from the 12th phase of South Pars, nonetheless, most of these activities have been on hold because of the sanctions against Tehran.

Table 8: Italy's existing, under construction and under consideration LNG terminals

LNG Terminal	Start-up	Capacity	Shareholders	Source
Panigaglia(La Spezia)	1971 (e)	3.5 bcm/y	GNL Italia	Algeria
Rovigo-North Adriatic(Isola Di Porto Levante)	2009 (e)	5.8 bcm/y	Qatar Petoleum (45%) Exxonmobil (45%) Edison Gas (10%)	Qatar
Livorno	2012 (u)	2.7 bcm/y	EON, Golar LNG, IRIDE, OLT Energy	

Brindisi	cancelled	8 bcm/y	British Gas of UK (BG) Egypt (100%)
Taranto (Puglia)	Not known (p)	8 bcm/y	Gas Natural
Porto Empedocle (Sicily)	2013 (p)	8 bcm/y	Enel/ Nuove Energie
Rada di Augusta Priolo (Sicily)	2014 (p)	8 bcm/y	ERG/ Shell
Porto Recanati off-shore	Not known (p)	5 bcm/y	GDF Suez
Gioia Tauro- San Ferdinando (Calabria)	2014 (p)	12 bcm/y	LNG Medgas Terminal
Rosignano Maritimo off-shore	Not known (p)	5 bcm/y	Api Nova Energia
Rosignano off-shore	Not known (p)	8 bcm/y	Edison/ BP/ Solvay
Zaule	2013 (p)	8 bcm/y	Gas Natural
Montefalcone	Not known (p)	8 bcm/y	E.ON
Vado Ligure (Liguria)	Not known (p)	5–9 bcm/y	Enel
Muggia (Friuli)	Not known(p)	5–9 bcm/y	Enel
Livorno-Olt Cross Gas Off-shore	Approval (p)	4 bcm/y	Endesa (51%) Amga (41%)
Trieste off-shore	Not known (p)	8 bcm/y	Endesa, Friulia

e: existing, u: under construction, p: proposed

Sources: by the Author on the basis of: the Energy Delta Institute, GLE LNG map 2011, NG Information OECD/IEA 2011, International Gas Union (IGU) World LNG Report 2010, King & Spalding 2006, The California Energy Commission (Western Europe LNG Map, July 2010), Global LNG Info. (May 2012).

Moreover, based on April 2005's Italian regulation, 20–year exemption of third–party access granted to 80% of the total capacity of each LNG terminal, showing that long–term/take–or–pay contracts are important in this country. Fifty percent of current ones (IEA 2010, Italy: 13), for instance, the off–shore Isola di Porto Levante LNG terminal (the North Adriatic) in the north–east, started the import of 8.1 bcm/y LNG from Qatar under a 25–year exemption to third–party access rules under the Second Gas Directive, while the remaining 20% will be available to the third–party access.

Some of the Italian LNG terminals, like Livorno have received the required permissions and some more projects look forward to authorisation. Nevertheless, according to the Law no. 99/2009 published in November 2007 by the Ministry of Economy and Finance, this procedure for new LNG plants has been eased.

2.9.3. Spain as the third Case Study

2.9.3.1. Geo–politics of Spain

The Kingdom of Spain, having joined the EU in 1986, is situated in the southern part of Europe and is bordered to the south and east by the Mediterranean Sea, to the north by France, Andorra and the Bay of Biscay; and to the north–west and west by Portugal and the Atlantic Ocean, making it the second largest country in the EU after France and also the fifth most populated country within the Union (www.energydelta.org/ country–profile–spain).

2.9.3.2. Spain's energy policy and energy security

On the basis of the Royal Decree 1716/2004 of 23rd July, CORES (The Corporation of Strategic Reserves of Oil–based Products, CORES by its Spanish acronym), established by the Ministry of Industry, Tourism and Trade, is responsible for the gas sector, and verifies the obligation on operators to diversify gas supplies, while the System Operator is the body in charge of sending reports regarding the natural gas and LNG and the capacities to the Directorate General for Energy Policy and Mines at the Ministry, approving conditions and terms over natural gas and LNG in Spain (www.cores.es/eng/home).

The Spanish gas sector and grid, including production, distribution and transmission, as well as the LNG regasification terminals at Huelva, Barcelona and Cartagena, out of the overall existing six facilities, is privately controlled by mainly Enagás, but the largest gas supplier in Spain is Gas Natural and Iberdrola and Repsol are the two major energy companies in this country (Platts, 4th July 2011: 3).

Spain has witnessed some energy regulatory changes since the late 1990s, principally by setting up "the Comisión Nacional de la Energía" in 1998, as the focal regulatory body of the energy systems in this country in order to provide "more transparency in the price formation mechanisms and liberalising the supply", based on the 1998 Hydrocarbon Bill (Németh et al. 2009: 7).

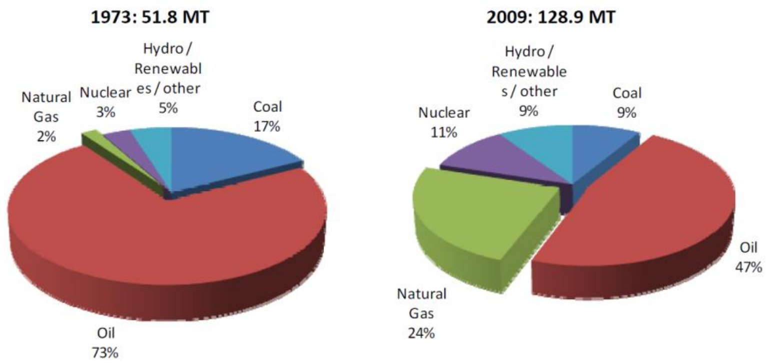
The gas market has been fully opened since 2003 (Eurostat Statistical Book, ISSN 1831–3256, 2009: 49) and the third–party access regime rules on Spanish LNG terminals, based on the Hydrocarbon Act 34/1998, based on the Commission Gas Directive 98/30/European Commission with the objective of creating a single European gas(King & Spalding 2006: 20); led to a more competitive situation. As a result, for the time being, more than 30 companies have been active in Spain (King & Spalding 2006: 2), so diversification of supplies is a principal policy in this country's energy policy, based on the Royal Decree 1766/2007 (www.cores.es/eng/cores/regulation).

2.9.3.3. Total primary energy sources demand and production, past, present, and the future in Spain

The total primary energy sources in Spain stood at 128.9 mtoe in 2009, rising nearly 150% from 1973 with 51.8 mtoe (figure 36) and greenhouse gases there increased up to 52% in the middle of the 2000s, compared to 1990 (Németh et al. 2009: 5), while the share of renewable energies in the energy mix has increased from 5% in 1973 to 8.7% in 2005 (figure 36 & table 1) and 9% in 2009, partly due to government policies to promote hydro, despite its frequent availability (Davidson, 2012: 11), wind and photovoltaic solar (IEA 2011, Spain: 4), particularly wind energy, as the second largest producer, behind Germany, and ahead of the US (Eurostat Statistical Book, ISSN 1831–3256, 2009: 49); even though, the EU's proposed renewable energy sources target for the country, until

2020, is 20% of final consumption (figure 36) an increase of around 220% from 2009. Some even argue that the Spanish final target by 2030 should be to achieve an increase of the renewable energies share in its energy mix up to the ambitious 46% target (Németh et al. 2009: 24), an enormous 510% jump from 2009. However, since 2005 to 2009 this growth has been under 3% (table 1).

Figure 36: Spain's total primary energy sources, 1973–2009



Source: IEA 2011, Spain: 4

In addition, nuclear power in Spain has increased from 3% of total primary energy sources in 1973 to 11% in 2009 (figure 36), and placed it 14th out of 15 EU's member states (figure 44). However, it is committed to phasing out its nuclear reactors by 2020 and replacing those with gas–powered facilities (Checchi, 2009: 29).

Based on the "Energy outlook to the 2030 horizon" (Németh et al. 2009: 11&12), and the "Energy Saving and Efficiency Strategy 2004–2012", as the second stage after the "1984–2004 Strategy", the Spanish government should achieve the objectives of the energy efficiency policies in line with the Commission's targets of 20% energy efficiency stated in some documents.

Natural gas demand has had the strongest growth in Spain's energy mix, particularly for the power generation, 52%, followed by the industrial and the residential sectors with 28% and 10%, respectively from less than 1 mtoe in 1973, 2% of total primary energy sources to nearly 32.2 mtoe in 2008 (around 38.2 bcm/y), 24% of this country's energy mix (figure 36), a 10% rise from the previous year (IEA 2011, Spain: 14), and is expected to grow in the future, so Spain needs to expand its gas infrastructure, such as LNG terminals (RREEF Research, 2011: 3)

Although, as it is clear in the figure mentioned, the share of crude oil has decreased from 73% in Spain's primary energy sources in 1973 to 47% in 2009, but it has kept its domination. Some difficulties, such as tensions between Algeria and Morocco during the 1970s and 1980s and also Spain's domestic economy being heavily reliant on oil imports were two main obstacles to this country's natural gas and LNG demands and the relevant industry development during that period (H. Hayes, 2006: 49–91).

The indigenous gas reserves in Spain are very small and its reserve–to–production ratio was nil at the end of 2009 (http://www.energydelta.org/Spain), while the production of gas stood at 17 mcm/y in 2007 and 2008. This country is highly reliant on gas imports to meet its growing consumption, one of the highest in Europe, particularly due to the rise in electricity demand and replacement of older generation nuclear and also coal–fired power plants by gas–fuelled power ones (King & Spalding, 2006: 20), so based on the Ministry of Industry's "Plan de Energías Renovables", the power generation should reach the ambitious target of 40 GW electricity in 2030, compared to the 2010's 20 GW (Németh et al. 2009: 11).

The consumption of gas increased from 2,323 mcm/y in 1985 to 35,821 mcm/y in 2010 and has converted this country to the 10th gas importer worldwide, according to table 13, issued by the IEA (Key World Energy Statistics, 2012: 13).

Table 9: Spain's key natural gas data

	1985	1990	1995	2000	2005	2008	2009	2010 *
Production (mcm/y)	249	1 394	415	162	158	17	-	48
Demand (mcm/y)	2 323	5 443	8 455	16 663	31 883	38 244	-	35 821
Transformation	*770*	*573*	*858*	*2 940*	*11 821*	*19 652*	-	-
Industry	*1 294*	*4 129*	*6 095*	*10 538*	*15 073*	*10 690*	-	-
Residential	*132*	*425*	*1 044*	*2 159*	*3 461*	*3 959*	-	-
Others	*127*	*316*	*458*	*1 026*	*1 528*	*3 943*	-	-
Net imports (mcm/y)	2 074	4 049	8 040	16 501	31 725	38 227	-	35 773
Import dependency	*89.3%*	*74.4%*	*95.1%*	*99.0%*	*99.5%*	*100.0%*	*0.0%*	*99.9%*
Natural Gas in TPES	*3.0%*	*5.5%*	*7.7%*	*12.5%*	*21.0%*	*25.0%*	*24.2%*	-

Source: IEA 2011, Spain: 2

2.9.3.4. Spain’s gas imports by pipelines and LNG outlook

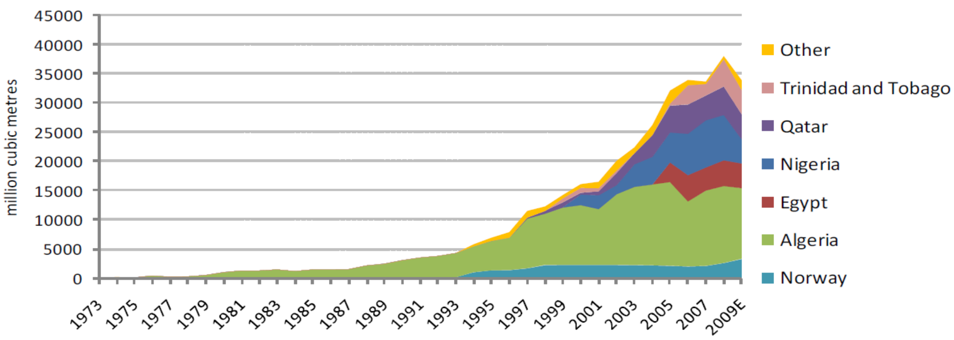
Spain’s gas imports by pipelines accounts for 26% of its demand, by two main routes from Algeria, such as the direct 8–bcm/y MedGaz deep–water pipeline from Beni–Saf to Spanish Almería without any transit countries, namely Morocco (IEA 2011, Spain: 14–16). This country has, moreover, four interconnected networks, two with France in Larrau (Navarra) and Irun (Guipúzcoa) and a further two with Portugal in Badajoz and Tuy (Pontevedra) in addition to a pipeline, having linked the Iberian Peninsula with the Balearic Islands since September 2008. However, interconnection capacities with France and the rest of continental Europe have been faced with limitations (IEA 2011, Spain: 15 & 16).

Map 4: Spanish natural gas and LNG Infrastructures

Source: IEA 2011, Spain: 16

Among the countries in the EU, Spain is the leading LNG importer and the 4th global importer (figure 40), according to IGU in its World LNG Report (2010: 25). As Prof. Gonzalo Escribano (annex 1) argued (interview on 26th April 2012), this country has well diversified its LNG import routes away from Algeria to other ones, such as Nigeria, Trinidad and Tobago and recently Qatar (figure 37), but he believed that Qatar's LNG expansion, if it happened (Chapter 4) could be important for the EU's security of supply in the future and also Spain, as one of the Union's entrances for LNG. He also stipulated that this volume of LNG imports is enough for Spain until the end of the current decade, while the new suppliers, such as Iran could be enter the market but unlikely before 2020, in order to meet increased Spanish demand and for transit to Europe (Shepherd, 2006: 268–319).

Figure 37: Spanish natural gas import by supplier



Source: IEA 2011, Spain: 1

On the basis of Hulbert's comments (interview, 2012), Algerian LNG exports will play the most important role in Spain's gas market in the future, particularly in the framework of long–term contracts, such as the 20–year LNG supply agreement by the Algerian Sonatrach with the Spanish power company Endessa (figure 27). For the time being, nearly 75% of the Spanish LNG terminals have been allocated to the long–term basis with more than two years, whereas 25% of its market is under short–term contracts of not more than two years (King & Spalding, 2006).

As of May 2012, in addition to the El–Musel terminal, currently under construction and the two facilities under consideration in the Canary Islands (Tenerife and Gran Canaria) (map 4),there are six LNG regasification terminals operating in Spain (table 14) with the potential increase of capacity up to around 60 bcm/y (IEA 2011, Spain: 16), compared to an estimated gas demand close to 36 bcm in 2010 (table 9), so this LNG expansion with its degree of flexibility, facilitates diversification of the supply (Németh et al. 2009: 8).

Table 10: Spain's existing, under construction and under consideration LNG terminals

LNG Terminal	Start-up	Capacity	Shareholders	Source
Barcelona (P)	P 1: 1968 P 2: 2010	P 1: 12.4 bcm/y P 2: 4.7 bcm/y	EnaGas	
Huelva (P)	P 1: 1988 P 2: 2006	P 1: 9.1 bcm/y P 2: 2.7 bcm/y	Enagas, Gas Natural (9.2%), Bancaja (5%), Sagane Inversiones (5.2%), BP Espana (5%), Others (70%)	The UAE, Algeria, Egypt, Libya, Malaysia, Nigeria, Oman, Qatar, Trinidad and Tobago
Cartagena (P)	P 1: 1989 6P 2: 200	P 1: 9.9 bcm/y P 2: 1.9 bcm/y	Enagas S.A	The UAE, Algeria, Egypt, Libya, Malaysia, Nigeria, Oman, Qatar, Trinidad and Tobago
Bilbao Bahia de Bizkaia (P)	2003 (due to be expanded)	7 bcm/y	BP (25%), Iberdrola (25%), Repsol (25%), Ente Vasco de la Energia (EVE) (25%)	The UAE, Australia, Algeria, Nigeria, Egypt, Libya, Qatar, Trinidad and Tobago
Sagunto (P)	P 1: 2006 P 2: 2009	P 1: 4.8 bcm/y P 2: 1.5 bcm/y	Gas Natural, Fenosa, Banco Pastor, Sonatrach, Caixanova, Tojeiro Group, Xunta de Galicia	Algeria
Reganosa (El Ferrol) (P)	2007(due to be expanded)	2.6 bcm/y	EnaGas	
Gijon (El Musel) (U)	2012	5.8 bcm/y	EnaGas	
Las Palmas de Gran Canaria (Arinaga)	2013	2 bcm/y	Gascan	
Santa Cruz de Tenerife (Arico-Granadilla) (P)	2012	2 bcm/y	Gascan	

e: existing, u: under construction, p: proposed

Sources: by the Author on the basis of: Energy Delta Institute, GLE LNG map 2011, Natural Gas Information OECD/IEA 2011, International Gas Union (IGU) World LNG Report 2010, King & Spalding 2006, The California Energy Commission (Western Europe LNG Map, July 2010), Global LNG Info. (May 2012).

The Spanish Ministry of Industry, Trade and Tourism published "POLES–Spain" (Prospective Outlook for the Long–term Energy System), based on a global model, and four energy researchers from the "Institute for Prospective Technological Studies" in Sevilla, worked on it and issued their own results in the European Review of Energy Markets (EREM) in April 2009. They argued that the Energy outlook to 2030 in Spain is on the basis of two scenarios, comprising:

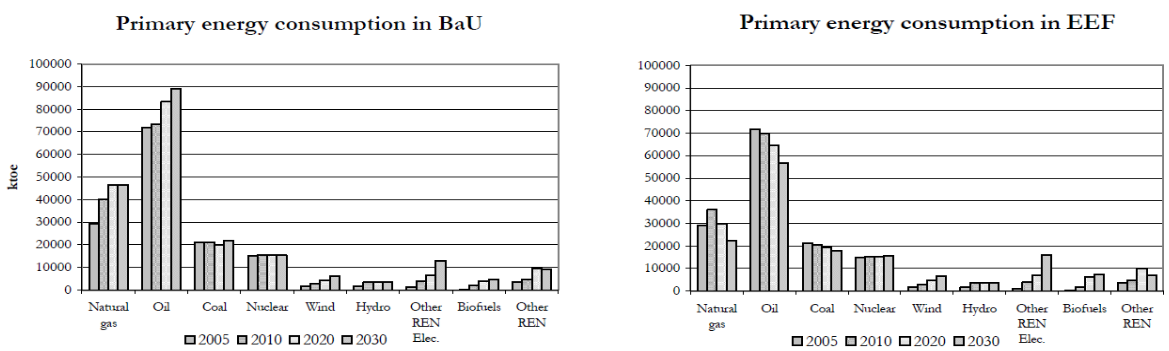
- ✓ Baseline scenario (BaU): The historical trends of the energy system continues without any additional policy influence, while the external energy dependency rate falls from 78% in 2005 to 72% in 2030 and also greenhouse gases remains 55% and 79% above 1990 levels in 2010 in 2030, respectively.

- ✓ Energy efficiency scenario (EEF): High international energy prices leads to the increase of the renewable energy sources share in energy mix and further energy efficiency, while the dependency on fossil fuel rate is expected to be 59% in 2030, more than 20% lower than the current statistics and also greenhouse gases will be 23% higher than the 1990 level in 2030.

As a result, under the former scenario the role of the natural gas in this country's energy system increases by 2020, and renewable energies, like gas, increases its weight in the Spanish energy mix during this period as well.

Indeed, in both scenarios the non–hydrocarbons grows considerably by 2020 and even beyond that. However, based on the latter scenario, the consumption of all fossil fuels decreases between 2010 and 2030.

Figure 38: Spain's primary energy consumption, 2005–2030



Source: European Review of Energy Markets (EREM), Vol: 3, issue 1, April 2009: 15

The IEA in its report in 2011, argued that the Iberian Peninsula gas market, as the European "gas island" (IEA 2011, Spain: 15) could become a big European gas hub if, in addition to these LNG terminals, sufficient interconnection capacity with France is added (IEA 2011, Spain: 16). Moreover Peimani, (interview on 4th March 2012) stressed that competitiveness, is an important factor to receive the required gas with affordable prices. He argued that any new natural gasand LNG supplier in the medium–and long–terms, such as from the Persian Gulf other than Qatar, could "fortify the Union and also main regional LNG importers' competitiveness and could not be ignored, because not only the EU but also Europe's domestic gas resource are rapidly depleting".

2.9.4. France as the fourth Case Study

2.9.4.1. Geo–politics of France

France, as the largest country within the EU–27, with long coastlines along the Mediterranean Sea, the Atlantic Ocean and the English Channel, has shared borders with Belgium and Luxembourg to the north, Germany, Switzerland and Italy to the east, and Monaco, Spain and Andorra to the south (en.wikipedia.org/wiki/France).

2.9.4.2. France's energy policy and energy security

The Ministry of Ecology, Energy, Sustainable Development and the Sea (MEEDDM), as the main governmental energy body in France, was created in June 2007 by a combination of separate entities, and has led to more coherence in energy policy making, so it oversees on energy issues and makes the final decision. Since 2008, the Directorate–General for Energy and Climate (DGEC), also influences energy policy–making, particularly in energy markets, security of supply, renewable energy sources, and nuclear power (Energy Policies of IEA Countries, France 2009: 17–20). Nevertheless, the Directorate for Energy (DE) within the DGEC is responsible for security of supply (Energy Policies of IEA Countries, France 2009: 77). The Energy Regulatory Commission (CRE), as an active member of the Council of European Energy Regulators (CEER), since its creation in March 2000, is in charge of cooperation between the EU regulators and also ensuring open access to all networks for both electricity and gas for various suppliers (www.cre.fr/en/presentation/missions).

Consequently, this country's liberalised gas market has been open to competition since the 1st July 2007 in compliance with the EU's rules and has fully implemented the Union's directive, such as the terms of the Second Gas

Directive by amending legislation passed in 2002 and 2003 (Energy Policies of IEA Countries, France 2009: 59). Accordingly, France's four key principles of the energy policy have been defined as follows: "security of supply, competitive energy supply, sustainable energy development and energy service to all territories and all citizens" (Energy Policies of IEA Countries, France 2009: 15).

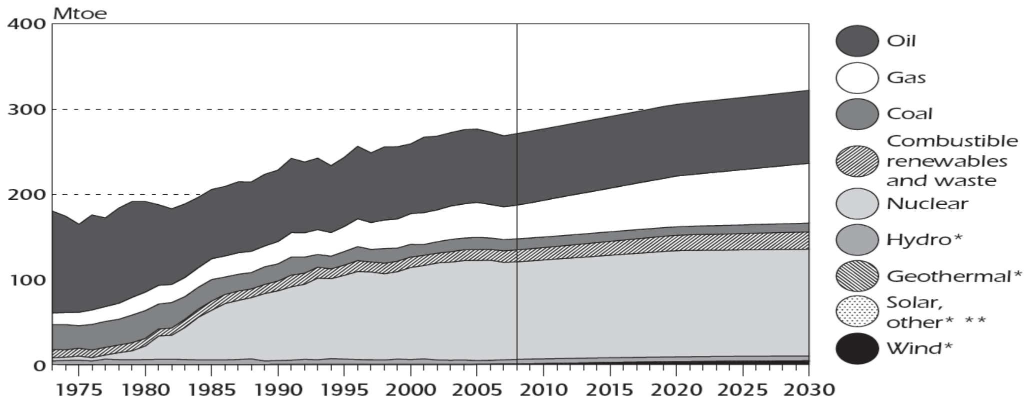
Paris has attempted to increase its energy security via encouraging more energy efficiency and the rise of renewable energy sources in total primary energy sources, particularly by Climate Plan 2004–2012, Energy Law 2005–781 of 13th July 2005 (www.ec.europa.eu/energy/demand/legislation/doc/neeap/france), diversifying of natural gasand LNG suppliers, increase of interconnection capacity in gas and power markets (Energy Policies of IEA Countries, France 2009: 27), such as "Gas Platform" initiative, as an intergovernmental policy in north–west Europe among Germany, France and Benelux (Belgium, the Netherlands and Luxemburg) with the proposal of a more integrated regional gas market (www.benelux.int/en/dos/dos15.asp). France has around 193,700 km of gas network, the second longest after Germany, while GRT gas operates about 87% of the nationwide grid and Total Infrastructure Gas France (TIGF) runs the remaining 13% in south–west (GLG 2011).

The National Strategy for Energy Research (SNRE) was adopted in France in 2007 with the aim of increasing energy security and to combat climate change (Griot, 2010) while renewable energies in this country at that time was 18.7 mtoe, equivalent of 7.1% of energy mix (Energy Policies of IEA Countries, France 2009: 88), ranking this country in the second position within the EU–27 and 13th among the IEA–28 countries. The EU's Energy Climate Package was enacted by the European Parliament in December 2008 (COM (2008) 19 final, 2008/0016 (COD), and this insisted that the share of non–hydrocarbons in France's total primary energy sources should reach 23% by 2020, compared to 10.3% in 2005 (table 7), approved by the French bill in August 2009 and also 9% energy efficiency by 2016, according to the French Directive on Energy End–Use Efficiency and Energy Services (2006/32/European Commission).

2.9.4.3. Total primary energy sources demand and production in France, past, present, and the future

In 2008, total primary energy sources was 266.9 mtoe with around 50% growth compared to 1975, while the nuclear energy accounted for 43% of energy mix in France, the highest share not only among the EU, but also amongst the IEA countries, followed by oil and natural gas with 31% and 15%, respectively (figure 39).

Figure 39: France's total primary energy sources, 1973–2030



Source: Energy Policies of IEA Countries, France 2009: 16

France's total energy self–sufficiency and domestic production is about 50% of its final total primary energy sources, mostly by nuclear (figure 39), and bio–fuels and also wind power, ranking it as the second in the EU–27 (Energy Policies of IEA Countries, France 2009: 88).

Nuclear energy has been developed in France in order to decrease its dependence on energy imports, following the oil crises during the 1970s, while in 2008 it accounted for 77% of the country's power generation, the first in Europe (figure 11) and 43% of energy mix (figure 39) with its 58 reactors (Energy Policies of IEA Countries, France 2009: 131).

Moreover, the role of gas among the other primary energy sources in France up to 2020 and 2030 will increase in comparison with other hydrocarbon and non–hydrocarbon sources. According to IEA (Key World Energy Statistics, 2012: 13), France is the 8th global and third EU gas importer after Italy and Germany with

41 bcm imports in 2011, (table 13), whereas it produced just 0.9 bcm gas in 2008 and according to the French government, the overall internal production will most likely cease by 2013 (Energy Policies of IEA Countries, France 2009: 58).

The share of natural gas in France is lower than the IEA European countries' average of 25%, because of its big share of nuclear power, while it is expected to increase the share of gas demand in the country to more than 75% of the existing scale by 2020 (Energy Policies of IEA Countries, France 2009: 57–58). The 2008/2009 gas crisis has impacted on France's natural gas and LNG supply strategy, so the French government has been developing "pluri–annual investment plans (PPI)" with the purpose of reaching the targets of new energy capacity by 2020 (Energy Policies of IEA Countries, France 2009: 27–28).

2.9.4.4. France's LNG import and its outlook

LNG accounts for more than 32% of France's natural gas basket, having commenced in 1964 and imports predominantly from Algeria, followed by Egypt, Nigeria and Qatar (table 11), making France the third importer of LNG within the EU after Spain and the UK and the 5th globally (figure 40) while the main gas exporters, via pipeline, to France are Norway, the Netherlands and Russia, mainly on the basis of long–term contracts (table 11).

Table 11: France's volume of natural gas and LNG imports by source, 2000–2008 (bcm)

	2000	*2005*	*2006*	*2007*	*2008*
Pipeline					
Norway	12.99	11.50	13.61	14.19	15.19
Netherlands	5.14	8.08	8.91	8.35	8.57
Russia	12.37	9.72	7.52	6.12	6.96
Germany	–	–	–	–	–
LNG					
Algeria	10.45	7.96	7.56	8.04	7.80
Egypt	–	1.55	2.33	1.19	1.04
Nigeria	–	–	0.54	0.50	0.43
Qatar	–	–	–	0.30	0.43
Other	**0.72**	**3.38**	**1.02**	**1.39**	**1.94**
Short-term purchases	**1.94**	**3.82**	**2.69**	**2.54**	**3.57**
Swap	**–**	**3.77**	**3.85**	**2.74**	**2.06**
TOTAL	**43.62**	**49.79**	**48.04**	**45.34**	**47.98**

Source: Energy Policies of IEA Countries, France 2009: 59

According to global LNG information in May 2012, Gaz de France and Elengy owns the three LNG on–stream terminals, comprising: Fos–sur–Mer near Marseilles since 1972, Montoir de Bretagne near Nantes since 1982 and Fos Cavaou. In addition, five more terminals have been under consideration (table 12) with the third–party access to LNG terminals, being guaranteed by the law of the 3rd January 2003 without any discrimination and with full transparency, under CRE supervision (Energy Policies of IEA Countries, France 2009: 67).

Table 12: France's existing, under construction and under consideration LNG terminals

LNG Terminal	Start–up	Capacity	Shareholders	Source
Fos–sur–Mer (Fos Tonkin)	Phase 1: 1972 (e) Phase 2: 2016	5.8 bcm/y 7 bcm/y	P 1: Elengy P 2: not clear	P 1: Algeria & Egypt P 2: Not Clear
Montoir–de–Bretagne I	1982 (e)	10.2 bcm/y	Elengy, Gaz de France	Algeria, Egypt, Nigeria, Norway, Qatar, Trinidad and Tobago, & Yemen
Fos–Cavaou	Phase 1: 2009 (e) Phase 2: 2020	6 bcm/y 8.3 bcm/y	P 1: GDF Seuz (70%) & Total (30%) P 2: GRT Gas	Algeria, Egypt & Qatar
Dunkerque	2014–5 (u)	13 bcm/y	EDF	Not Clear
Le–Havre/ Antifer	2015 (p)	9 bcm/y	GRT Gas	Not Clear
Fos Faster	2016 (p)	8–16 bcm/y	Vopak (90%) & Shell (10%)	Not Clear
Montoir II	2014 (p)	2.5 bcm/y	Elengy	Not Clear
Montoir III	2017 (p)	4 bcm/y	Elengy	Not Clear

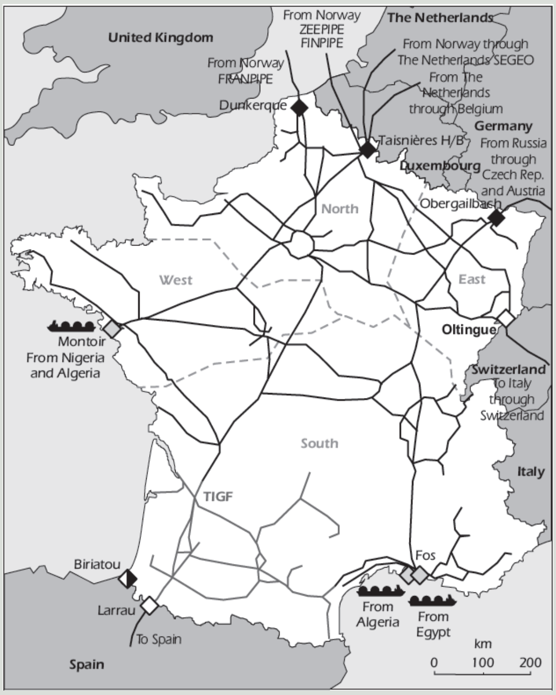
e: existing, u: under construction, p: proposed

Sources: by the Author on the basis of: the Energy Delta Institute, GLE LNG map 2011, NG Information OECD/IEA 2011, International Gas Union (IGU) World LNG Report 2010, King & Spalding 2006, vopaklng.com, The California Energy Commission (Western Europe LNG Map, July 2010), Global LNG Info. (May 2012).

Thierry Coville (annex 1) believes (interview on 18th April 2012) that France alongside the other EU major LNG importers should consider importing from not only African suppliers, but also some other existing and future producers, particularly from the Persian Gulf, with nearly 40% of global gas reserves, especially with Qatar's expansion and Iran's LNG exports. Greater diversification leads to further competitiveness, hence he called this energy security as one of the most important issues for the Union.

Clément (interview, 2012), moreover, argued that, despite bilateral old economic relationships, such as some French energy companies' partnership in Iran, "France has tightened its policy on Iran following the presidency of Nicolas Sarkozy in May 2007 and, as a result, the activity of these companies seems complicated, however it might be that under the new government, presided over Socialist François Hollande the situation will change". On the basis of the Natural Gas Information 2011, published by IEA, France, with the long coastline and large area in the heart of the EU, works as another gas hub for a couple of other European countries (RREEF Research 2011: 3), so about 15% of the imported gas from Norway and Nigeria is destined for transit to Spain and Italy, while the new LNG terminals in these three EU countries alongside the expansion of interconnections and a relatively integrated system will impact on transit gas flow in the future and finally enhance the security of supply in the EU (Energy Policies of IEA Countries, France 2009: 60–62), showing that "the security of supply becomes regional, rather than national" (Energy Policies of IEA Countries, France 2009: 31).

Map 5: France's gas Infrastructures



Source: Energy Policies of IEA Countries, France 2009: 61

Luciani (interview, 2012) argued that the future of the EU's natural gas and LNG demand for imports is extremely uncertain, while some unexpected issues occur, such as the Fukushima disaster in 2011, which lead to increased demand for LNG in the Far East. As a result, the required measurements should be adopted, such as the enhancement of existing and future LNG terminals, not only in France but also in other EU countries, in efforts to meet the expected and unexpected demands.

France will attempt to increase its security of supply by the development of its natural gas and LNG infrastructures, regional cooperation, long–term contracts with producing countries and diversifying suppliers and routes (Energy Policies of IEA Countries, France 2009: 30).

2.10. Perspective of the EU–4 LNG importer

Luciani (interview, 2012), believes that the EU's demand for imported LNG in the future depends on "the level of economic growth in the Union, which is not what scenarios are based upon, on shifts in the European energy balance (how much nuclear, how much coal, how much renewable energy sources etc.), and on the potential for domestic production from unconventional gas sources". Nevertheless, Laura El–Katiri (interview, 2012) also added winter weather conditions or seasonality (peak demand), and, to some extent, the kind of LNG term or spot contracts to Luciani's factors.

Regarding the LNG terminals in the EU and the whole of Europe, there are four facilities which have been under construction in Spain, Italy (the Brindisi LNG Terminal has been cancelled), France, and Poland, while 12 more terminals have been under consideration (five of them have been suspended in Germany, Cyprus, France, and the UK, while one more in the Netherlands' was cancelled). Hence, the remaining seven planned regasification terminals in order to respond to growing LNG demand in the future are together to the existing LNG import terminals, being operational in the EU, of which more than three–quarters of them are in the four case studies in this research, and in the Union, according to the newly–published document by Global LNG Information, May 2012 (annex 11) and, moreover, these four main EU's LNG importers are among the top 10 gas importers worldwide (table 13),whereas Spain, the UK and France are the 3rd, 4th, and 5th global LNG importers respectively and Italy is the 10th one (figure 40).

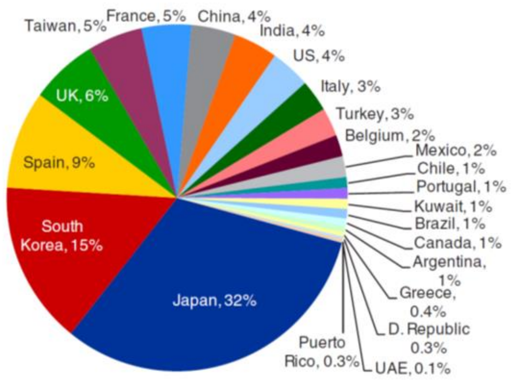
Table 13: The main global gas importers

Net importers	bcm
Japan	116
Italy	70
Germany	68
United States	55
Korea	47
Ukraine	44
Turkey	43
France	41
United Kingdom	37
Spain	34
Others	279
total	834

Source: IEA, Key World Energy Statistics, 2012: 13

To sum up, there is a total of 31 LNG terminals in the EU that are either existing, under construction, or proposed, except cancelled and suspended ones. Seven of them belong to other EU countries (table 14), while 24 of them are situated in the four EU's member states of Spain, Italy, the UK, and France, close to 80% (annex 10) and these countries

Figure 40: LNG importers by Country in 2010



Source: IGU World LNG Report 2010:8

import for their own use nationally or transport to other countries regionally or continentally.

Bahgat (interview, 2012) indicated to the EU's policy regarding the single and competitive gas market that "once gas shipments arrive any place in the EU, they can be moved within the Union", so these four EU's LNG importers play an important role to transport more imported of this sort of gas product not only for their own domestic consumption, but also to other member states in the new EU integrated energy market (Rosner, 2009: 160–176).

As analysed in this chapter, Europe has converted to the second global gas consumers since the middle of the 2000s and this trend will continue until 2030 and possibly beyond. However, this continent will produce the least gas worldwide by then (figure 14).

Table 14: The Europe's existing, under construction and under consideration LNG terminals

other EU	Country	Project Name	Start-up	Capacity	Shareholders
	Belgium	Zeebrugge (Expansion) (e)	2008	3.3 bcm/y	Fluxys
	Greece	Revithoussa (Expansion) (e)	2007	2.7 bcm/y	DEPA
	The Netherlands	Gate, Maasvlakte (Groningen) (e)	2011	8.8 bcm/y	Dong, EconGas OMV, EON, Gasunie, RWE, Vopak
		LionGas (p)	Cancelled		

	Poland	Swinoujscie (Gdansk) (u)	2014	3.6 bcm/y	Gaz–System SA
	Portugal	Sines LNG (Expansion Phase 1) (e)	2012	3.4 bcm/y	REN
	Sweden	Nynashamn (e) (Brunnsviksholme) LNG	2011	0.3 bcm/y	AGA Gas AB
	Cyprus	Vassiliko (p)	Suspended	0.7 bcm/y	Cyoriot Governmet/ Cyprus Energy Authority
	S.Ireland	Shannon LNG (p)	proposed		Shannon LNG
	Germany	Wilhelmshaven (p)	Suspended	10 bcm/y	E.on
Non-EU	**Turkey**	(Izmir) Aliaga LNG (e)	2006	4.4 bcm/yr	Egegas
		Marmara (e)	2009		
	Croatia	Adria(p)	proposed		
	Albania	Levan (Falcione)(p) semanGas (ASG)(p)	proposed		

e: existing, u: under construction, p: proposed

Sources: by the Author on the basis of: the Energy Delta Institute, GLE LNG map 2011, Natural Gas Information OECD/IEA 2011, IGU World LNG Report 2010, King & Spalding 2006, The California Energy Commission (Western Europe LNG Map, July 2010), Global LNG Info. (May 2012).

In addition, according to the analytical statistics, referred to chapter 4 and also in figure 25, unconventional gas might be commercially viable in 2030 in Europe with just more than 1% of global gas production. On the basis of the figure 24, Europe will turn in to the biggest LNG importer worldwide after 2020 and this trend will continue to increases dramatically. In 2010, 19.6% of global LNG imports was directed to the EU, while 17% of global imports, equivalent to nearly 87% of the whole Union's LNG import headed to the UK, Spain, France, and Italy (table 15).

Table 15: The outlook of the world and Europe's LNG imports, capacity and percentage

Location	Current capacity	Imports in 2010	Global percentage	Prediction	Future capacity
World	570 Mt	271 Mt/ 368.5 bcm	100%	540-566 bcm (2020) over 680 bcm (2030)	680 Mt (2015)
The EU	171 bcm (2010) 186 bcm (2011)	100 bcm	26.4%	160 bcm (2020) 220-300 bcm (2030)	259 bcm (2015)
Spain	56.7 bcm	33 bcm	9%	-	9.8 bcm
The UK	39.3 bcm	22 bcm	6%	-	22.4 bcm
France	22 bcm	18.4 bcm	5%	-	53.8 bcm
Italy	17.3 bcm	11.1 bcm	3%	-	98 bcm
Other EU	15 bcm	12.5 bcm	3.4%	-	7 bcm
Other Europe (Turkey)	5.8 bcm	11.1 bcm	3%	-	-

Source: by the Author on the basis of: IGU World LNG Report 2010, King & Spalding 2006, GLE Map and GLE Investment Database 6th Sep 2011, CEDIGAZ 24th June 2011, BP 2012, Energy Outlook 2030, IEA Special Report 2011: 45.

Of the four LNG terminals under construction and the six which are under consideration in the EU, eight of them, nearly 80%, are located in Italy, the UK, France and Spain, in addition to the on–stream regasification terminals. Hence, by growing role of LNG in the Union's gas market in the future, these four countries will be much more important in the future not only for the Union, but also for the whole of Europe, because for the time being, there are only two online terminals, operating in Turkey and three proposed terminals (table 14) which will be in Croatia and Albania.

2.11. Conclusion

Natural gas is projected to be the fastest growing fossil fuel all over the world and, unlike the US, security of supply within the EU means security of gas supply. The need for more gas supplies has been highlighted not only from decreasing levels of European indigenous gas production, but also from a firm increase in demand. The high gas import dependence on a special supplier is a great concern for the EU. On the one hand, LNG is profitable compared to pipeline in long distances and is far more flexible as it is possible to change suppliers without crossing several borders and conflict areas, as well as more short–term volumes in the market. LNG import outlook in the EU will rise to 24% by 2020, a 60% increase compared to 2010. European continental production will drop from nearly 280 bcm/y in 2010 to 222 bcm/y in 2020, and LNG share will be doubled from 85 bcm/y to around 160–170 bcm/y during the same period of time. Europe will need extra gas, between 80–100 bcm/y, coming from pipelines.

The statistics published by the European Commission, OME, Eurogas, CIEP, BPG, and CEDIGAZ over the future of EU gas needs vary from 550 to 670 bcm/y, based on low and high demands, in the period from 2015 to 2020. The amount of gas imports would depend on the implementation of energy efficiency and renewable energy sources policies within the EU by 2015 and 2020, as well as the number of EU's pipeline projects from gas producers which would materialise. According to CIEP, Gasprom, and GASTERRA, by 2015, European gas production will be around 130 bcm/y, excluding Norway, while the current EU's LNG import is roughly 85 bcm/y. So, the range of natural gas import by pipelines vary from 330 to 410 bcm/y, based on how many of these projects will be realized. As a result, the requirement of additional LNG to the EU may vary from zero to nearly 135 bcm/y by 2015 and of course more than this number by 2020, because of high demand and low EU's indigenous production. If the EU is to achieve its 20/20/20 plan by 2020, and its energy policy targets are at an average level by

2015, based on reduced growth demand between high and low growth demands, and also if half of its pipeline projects are inaugurated, then, this region should import around 60 bcm/y LNG in addition to the current level of 85 bcm/y by 2015 and around 175 bcm/y by 2020.

Spain, Italy, France and the UK have large LNG projects under way, so that nearly two–thirds of current facilities together with those that are planned, approved, and under construction are located within these four countries for use by them, as well as for transport inside the EU and landlocked member states. It seems that the countries in the Middle East, especially from the Persian Gulf, with nearly one–third of global natural gas deposits, are expected to become significant suppliers. If some of the difficulties can be removed, this game could be turned into a win–win situation for both main parties.

The EU's decision concerning more use of gas in power generation started in 1992, while the Union has been trying to switch to a low–carbon society by energy efficiency and renewable energies since 1997. So, the EU is trying to increase the share of renewable energy sourcesin its total primary energies from 12% in 2010 to the ambitious target of 20% by 2020, based on the "energy trinity" adopted as the main EU's energy policy, including sustainability, competitiveness and security of supply.

For the EU, energy security will matter, while it emphasises on solidarity and regional cooperation initiatives, such as liberalization of energy markets. What the European Commission expects is to consider decisive moves beyond the unilateral actions by the member states. In sum, the EU considers its energy security issue regionally, instead of nationally. On this basis, security of LNG supply within the Union has been investigated regionally in the framework of the new regionalism theory in this research, as its features were discussed in Chapter 1.

According to some predictions, the share of nuclear energy in the EU electricity generation will decrease from 31% to 21% by 2020. Moreover, the EU Commissioner for Energy believes that under the current regional situations, the

Union will attain 9% in energy efficiency instead of 20% by 2020. On the other hand, Europe has become the second global gas consumers since the middle of 2000s, and BP, in its most recent report in 2012, has anticipated that this continent is expected to import around 80% of gas needs by 2030. Therefore, security of supply, as the "Gulliver in chains", is important for the EU with its two internal and external dimensions and the shortest way in which to ensure the security of supply is diversification of gas suppliers. Europe, moreover, will turn in to the biggest global LNG importer after 2020. In 2010, 19.6% of global LNG imports were to the EU, while nearly 87% of them were imported by the UK, Spain, France, and Italy. The share of LNG has mounted in the EU's gas import during recent years and it is expected to dramatically rise, so the role of these four countries will be enhanced, particularly as nearly 80% of total Union's LNG terminals, existing, under construction and proposed are located in their territories in order to cope with growing domestic demands and also to facilitate transport inside the EU via the single gas market.

The UK's Energy White Paper in 2003 and also DECC in its annual energy statement on 23rd November 2011 insisted on real progress in reducing greenhouse gases by 2020 and 2050, diversifying of energy sources and routes in a more liberalised and competitive gas market with affordable prices in order to ensure this country'senergy security in the future. Based on the EU's document, the UK should raise its renewable energies share in total primary energy sources from 1.3% in 2005 to 15% by 2020, the largest percentage among the EU's member states with roughly 1200% increase that needs to around £14 bn investment. The natural gas share increased from 12% of total primary energy sources in 1973 to 40% by 2009, and the UK became the 8th gas importer worldwide in 2011 and 4th LNG importer in 2010, while the imported hydrocarbons could still account for more than 70% of UK's energy consumption in 2025 and even between 40% to 60% of in 2050, depending on various conditions, such as the share of the renewable energies in total primary energy sources and energy efficiency. It is envisaged that the gas consumption in this country will fall between 14% to 27% by 2020. Nonetheless, the domestic production will fall over the same period, demonstrating that the UK's gas import dependency will increase. Furthermore, peak natural gas demand within this country increased to approximately 600 mcm/d in 2010–2011, whereas the peak of LNG demand in this country will be almost 170 mcm/d by 2020 and this trend will carry on rising until 2030. DECC in its annual energy statement, issued on 23rd November 2011 emphasised growing of natural gas in the UK's energy mix in the future, necessitating new gas and LNG plants. The National Grid also suggests that the UK should increase its own natural gas and LNG import capacity to around 193 bcm/y up to 2020 and the LNG import capacity should reach approximately 60 bcm/y by the end of the current decade and this volume of imports will probably peak until 2030. Hence, it means that if the whole of the proposed British LNG projects materialise, its final capacity will increase to about 60 bcm/y.

Oil and natural gas have dominated in Italy's total primary energy sources by 82–88% since the 1970s, while the share of renewable energies increased from 5% in 1973 to 8% in 2008 and should reach the EU target of 17% by 2020, but the development of non–hydrocarbons has been slow and needs to nearly €5 bn venture just until 2013. In addition, the government is to abandon its plans on nuclear power plants. Italy is the largest European gas market behind the UK and Germany while its gas demand has grown close to 350% between 1973 and 2008 because of the growing use of gas in power generation and also the reduction of oil's share in total primary energy sources. However, its domestic gas production is very restricted; hence import dependency on natural gas in Italy stood at approximately 90% in 2009, turning it in to the third global natural gas importer in 2011 and is set to increase to over 95% by the 2030s. Moreover, Rome's LNG import is roughly 12% of its gas demand and it has decided to increase its profile as the natural gas and LNG hub in the EU, with the most proposed LNG terminals within the Union.

The share of renewable energies in total primary energy sources in Spain increased from 5% in 1973 to 9% in 2009 and should achieve the target of 20% by 2020, an increase of roughly 220% from 2009 and the ambitious 46% target by 2030, equivalent to a 510% jump from 2009. Nonetheless, between 2005 and

2009 this growth has been less than 3%. The Spanish government is also set to phase out their nuclear reactors by 2020 replacing those with gas-powered facilities. On the other hand, gas demand has had the strongest growth in Spain's total primary energy sources, from 2% of energy mix in 1973 to 24% of this country's primary energies in 2008 and is expected to grow in the future, so Spain needs to expand its natural gas and LNG infrastructures. The indigenous gas reserves in Spain are very small and its production was equal to nil at the end of 2009, so this country is highly reliant on natural gas and LNG imports to meet its growing consumption, the 10th global gas importer, owing to the rise of electricity demand and replacement of older generation nuclear and also coal–fired power plants by gas–fuelled power ones. There are six LNG terminals on–stream in Spain with the potential increase of capacity up to around 60 bcm/y, converting this country in to the 3rd LNG importer worldwide and lead in the EU, hence, Spain within the Iberian Peninsula gas market, as the European "gas island" could become a big European gas hub.

France has attempted to increase its energy security by encouraging more energy efficiency and the rise of renewable energy sources in total primary energy sources, diversifying of natural gasand LNG suppliers, increase of interconnection capacity in gas and power markets. This country is the second EU member in terms of using renewable energies, particularly nuclear energy in the energy mix with the share of 10.3% in 2005, being expected to reach 23% by 2020, more than 75% of the existing level. The share of natural gas in energy mix will increase up to 2020 and 2030, while this country was the 5th global and 3rd continental gas importer in 2010 and, according to the French government, the internal production will most likely cease by 2013. Paris is the 3rd importer of LNG within the EU and the 5th globally, though LNG accounts for nearly 25% of its gas basket. France, with the long coastline and large area in the heart of the EU, works as another gas hub for a couple of European countries, while the new LNG terminals in these four EU countries, alongside the expansion of interconnections and relative integrated systems, will impact on transit gas flow in the future and finally enhance the security of supply in the Union. Consequently, by the growing role of LNG in the EU's gas import share, these four countries will be more significant not only for the Union, but also for the whole of Europe in the future.

Chapter 3: Energy geo–politics of the Persian Gulf's and the regional security systems

3.1. Introduction

The position of the Persian Gulf, in terms of geo–strategic and geo–politics aspects, has attracted the attention of most great powers, during the recent centuries, while the discovery of crude oil in the early period of the 20th century, as well as the commercial supply of natural gas during the later years, has been highlighted the importance of its geo–economic situation.

These developments led to the increasing presence of the Western companies, mostly from Britain, in the region during the first half of the 20th century and from then until the independence of Arab Sheikdoms in the early 1970s.

However, oil was a commercial commodity in most Sheikdoms after the 1950s and the black gold affected delineation after the British departure from the region, while the Persian Gulfstates, mostly monarchies, made little effort to demarcate their territories whilst under the Britain colonial system, hence territorial skirmishes have occurred since the early 1970s amongst the regional states bilaterally or multilaterally, some of which are still in place.

So, it could be said that the growing presence of outsiders alongside boundary disputes are the major consequences of commercial hydrocarbon supply from the Persian Gulfregion geo–politically. The commercial supply of natural gas has increased the importance of the Persian Gulf from a global perspective due to increasing world demand.

Since British military departure from the east of the Suez Canal, the US replaced it as an external balancer and tried to control Persian Gulf's oil and petrodollars as a means to limit its rivals. So, the regional order can be better understood largely under the Cold War strategic context.

The Islamic revolution in Iran in 1979, changed the status quo and then the Iran–Iraq war, led to establishment of the GCC in 1981. These developments, basically, divided the region in to three sections, comprising the GCC, as the core, non–GCC Arab Iraq alongside non–Arab Iran, as the periphery, as well as having the powers of intervention. The results of this balance of power have been nothing except conflict and rivalry, but also relative cooperation. Political disputes and scarcity of confidence not only have been clear inside the GCC, but also between this Council and the periphery, especially Iran and other interested player(s). Tehran's growing role in the region and its nuclear program has been the two controversial issues with regional and extra–regional players.

Nonetheless, security and stability in the Persian Gulf, with the world's largest hydrocarbon reserves, are more important not only for all regional states, but also for the international system.

In a region where hydrocarbon is king and security is risky, the reliance on the oil and gas supply from the Persian Gulf will increase in the coming years and even decades, while the littoral countries, indeed, have a structure of "mono–base economic", based on oil and gas exports. So, the energy security of both exporters and importers is affected by stability, less stability or instability in the region. So, the continuation of the Iraqi crisis, the American–Iranian situation and the current mutual approach between Tehran and some monarchies could lead to more regional instability. Therefore, on this basis, the new political and security structure of the Persian Gulf region should be redefined according to new developments after Baath Party era in Iraq, the role of Iran, as well as the Arab spring. This achieved security model within the Persian Gulf region should be based on confidence–building and détente between the core and periphery and then develop to broader model to ensure the mutual security of LNG supply with the EU.

By analysis and synthesis of the Subordinate System theory and the GCC's Eastward Orientation policy towards the Asia–Pacific region, the author concluded that the so–called "EU–[GCC+2]" is an appropriate security model to ensure the regional security of LNG supply between the EU and the Persian Gulf region, in accordance with the balance of interests, as the win–win game.

Therefore, four main questions are raised in this chapter:

- How is the energy position in the Persian Gulf's geo–politics?
- What is/are the consequence(s) of this energy position in the Persian Gulf's geo–politics?
- How does the current security model within the Persian Gulfimpact on regional energy policies?
- What is the most appropriate security model for the Persian Gulfin order to ensure its energy security?

3.2. Geo–politics of the Persian Gulf and the presence of the powers

The Persian Gulf is a shallow semi–enclosed sea with a surface of 260,000 km^2 between the Arabian Peninsula and Iran and links the three continents of Asia, Europe and Africa. The average and the maximum depth of its waters is nearly 40 metres and around 100 metres, respectively. It is bordered by Oman and the United Arab Emirates on the south, Qatar, Bahrain and Saudi Arabia on the west and south west, Kuwait and Iraq on the north–west and Iran along the entire north coast. It has been an important waterway for centuries, helping to establish trade connections with India and China in the Middle Ages.

The position of the Persian Gulf, in terms of geo–strategic and geo–political aspects, has attracted the attention of the great powers and produced important conflicts and competitions regarding control of this area for a long time (Naji & Jawan, 2011: 2). Owing to its strategic and geo–politics location, the Persian Gulf region has been, primarily, the centre of attention for European powers', who began to be present in the Indian Ocean and South–east Asia. The Portuguese were the first western power to enter to the Persian Gulf, followed by the Netherlands, France, and finally Britain (Luciani, 2005: 149–154). Turkey's Ottoman Empire, furthermore, controlled most of the region at different periods over a seven–century until the First World Wide.

During the 20^{th} century, on the basis of some scholars' arguments the Persian Gulf turned in to a place of hugely strategic importance for the global powers.

Alfred Thayer Mahan, in an article published in the National Review in 1902 concluded that the control of the Persian Gulf could result in the domination over all means of access that lead to the Far East, India and Australia.

The Middle East/Persian Gulf was called by Mackinder as the "World–Island" and Nicholas Spykman (1893–1943) believed that the Persian Gulf, and in particular Hormuz Strait, is one of the Rimland keys geo–strategically connecting the northern, southern, western and eastern parts of the Rimland to each other. Based on this comment, the control of this region alongside its sensitive strait means the control of earlier mentioned four parts.

3.3. The Persian Gulf's position after the discovery of hydrocarbons

3.3.1 More attention towards the Persian Gulf

At the beginning of the twentieth century, in 1908, oil was discovered for the first time in the Persian Gulf area and also in Iran, followed by Bahrain and Saudi Arabia in 1932 and 1933. This resulted in drawing much more attention to the region once again, such as the British Anglo–Persian Oil Company (APOC) or the current BP (British Petroleum) Company's activities in Iran's oil industry since its establishment during the first half of the 20^{th} century.

The Second World War delayed development of oil fields that had been discovered in the 1930s, so considerably smaller fields in Qatar came in commercial quantities in the 1950s, and the United Arab Emirates also began to export off–shore oil in the mid–1960s (Kandiyoti, 2008).

Until the 1970s, foreign companies, in most cases, European, as well as the US–based concerns, owned and managed the Persian Gulf oil industries by creating the subsidiaries in specific countries. In fact, discovery of oil in the Persian Gulf made the region considerably important not only for Britain but to all those who needed the oil. Initially, BP, and Royal Dutch Shell dominated the region, reflecting the European concern for secure sources of petroleum (Chapman & Khanna, 2006: 507–519).

During the 1970s, most of the regional Arab countries were independent of British control and bought the major shares of the subsidiary companies that worked within their borders, so by the early 1990s, many of these branches had become completely state–owned concerns (Kandiyoti, 2008: 76).

As a result, after withdrawal of the British military from the "East of Suez", such as the Persian Gulf region in the late 1960s, the US and actually the "Pax Americana" (Luft, 2011) took over the role of "an external balancer" (Bauer et al. 2010), cooperating with regional allies (Oktav, 2011:136) and, until the end of the 1980s, the regional order can be explained largely under the Cold War strategic circumstances (Aarts & Duijne, 2009: 65). Consequently, the US tried to control Persian Gulf's oil as a means to limit its rivals such as China, Russia, and even the EU (Aarts & Duijne, 2009: 73) and petrodollars could be considered as a factor in giving shape to the type of military procurements (Ehteshami, 2003: 263).

Since the beginning of gas supply commercially in recent years, moreover, the geo–politics and geo–economics of the Persian Gulf, has increased dramatically. The Middle East holds 40% of global reserves, almost all of which are situated in the Persian Gulf, as the gas–richest area worldwide (BP Statistical Review of World Energy, June 2011), so four of the littoral states within the Persian Gulf, out of eight, are among the top seven natural gas holders worldwide (EIA International Energy Outlook 2011: 64).

As a result, this area sits on top of the largest hydrocarbon reserves worldwide, whereas the increasing global demands, strengthened the regional positions geo–politically, geo–strategically, and also geo–economically (Chapman & Khanna, 2006: 507–519).

3.3.2. Regional Delineation

While oil was discovered in most of the Persian Gulf coastal states before the Second World War, however, it was commercial in most Sheikdoms, as the "neo–patriarchal governments" (Davidson, 2012: 10) after the 1950s and the black gold took effect on delineation after the British departure from the region and the subsequent boundary disputes, as, in advance of the oil era, the Persian Gulf states, mostly monarchies, made little effort to delineate their territories. This will be dealt with in next section.

3.4. The end of status quo in the Persian Gulf

Notwithstanding the huge wealth in the Persian Gulf, these vast hydrocarbon reserves have been often the source of regional and international tensions.

The Islamic revolution in Iran in the late 1970s, devastated the status quo (Oktav, 2011) and eventually the Iran–Iraq war, led to establishment of the GCC in 1981 (Kandiyoti, 2008: 35) with the shared Islamic cultural, social, political and economic backgrounds.

So, this organization is the core section within the Persian Gulf region, as the subordinate system of the Middle East, whereas Iraq, as a non–GCC Arab country and non–Arab Iran in this area represent the periphery of this system differing from the core sector in some cohesion levels by economic, organizational, social, or political factors. They do, however, play an important role in the politics of this subordinate system alongside the power(s) of intervention (Cantori & Lospiegel, 1969: 361–380).

The Persian Gulf area's structure and relations are, however categorised by conflict, rivalry and relative cooperation over recent decades and the intrusive player(s) in the Persian Gulf area, especially the US in addition to Britain and France, have influenced regional policies (Davidson, 2010a: 2).

The Persian Gulf together with East Asia/West Pacific have been the major two regions that the Pentagon has established its combat force structure and deployed aircrafts carriers and marine expeditionary units there during the recent decades for any probable military operations (Pascual & Elkind, 2010: 67 & 69).

Nevertheless, some other external actors, such as Turkey, Russia, China, India, Japan, South Africa or Brazil have indicated their willingness to get engaged in regional Affairs (Bauer et al. 2011).

Nonetheless, the Persian Gulf has witnessed a range of disputes within the GCC, between the core and periphery, as well as inside the periphery, such as territorial, ideological, political and nuclear, despite commonalities.

3.4.1. Differences inside the GCC

3.4.1.1. Boundary and political disputes

The GCC countries have faced some internal and external pressures (Davidson, 2012: 2). Creation of an indigenous "rentier elite class" with emerging of the new educated youth class, mass–communication (Davidson, 2012: 5), some injustice and inequality against Shia population, unsustainable subsidies, huge expatriate labours alongside voluntary internal unemployment, as well as corruption of the ruling families are amongst the internal problems that these Sheikhdoms have already encountered with them (Davidson, 2012: 230).

However, Christopher Davidson in his newly–published book argues (2012: 11) that high economic resources, small populations and governmental distribution of wealth are the main pillars of legitimacy within these Sheikhdoms.

As noted in section 1.3.2, boundary disputes are the primary issues of concerns amongst some GCC members that are or have been involved commercial oil production. Before the oil era, moreover, the Persian Gulf states, mostly monarchies, made little effort to demarcate their frontiers. Nevertheless, most of the boundary conflicts amongst these monarchies have been already resolved, such as the Dolphin project (Dargin, 2008: 18–19), Qatar–Bahrain over the Hawar Islands, Oman–Saudi Arabia, as well as others (E. Wiegand, 2012: 95), but some are still ongoing, such as those involving the United Arab Emirates and Saudi Arabia, as well as the United Arab Emirates and Iran.

There have been some political differences among the GCC member states, mostly regarding the elder Sheikdoms, Saudi Arabia and also Iran.

Some junior monarchies have accused Riyadh of developing not only its own perceived position as the most influential country in the Arab world (Burke & Bazoobandi, 2010: 13) but also its hegemony on the part of the GCC's smaller states (Oktav, 2011:142). Saudi Arabian explicit opposition with the United Arab Emirates–Bahrain's bilateral 2004 Free Trade Agreements with the US is one example regarding the internal political disparities within the GCC (Dargin, 2008: 18).

Furthermore, the Arab Sheikhdoms have already endeavored to take shape a single economic block with one common currency, however after decades of discussion, these efforts are still moving forward at a "snail's space" (Maloney, 2010: 51).

So, some of these littoral Arab countries have attempted to adopt an independent approach apart from the Saudis and even compete with the biggest Arab state's foreign policies. For instance, Qatar–based satellite station Al–Jazeera has been the main rival for Al–Arabia, causing a number of media and political confrontations with Saudi Arabia between 2002 until 2008. These include the pragmatic Doha (Burke & Bazoobandi, 2010: 8) ties with pro–Iranian Hezbollah in Lebanon, Hamas Movement in Gaza and Zaydi Shia rebels in Yemen.

As mentioned in advance, these Sheikhdoms have faced a number of external pressures, in addition to the internals challenges. Close military relationships with some western countries and their bases inside these monarchies' soil (Davidson, 2012: 169&170), efforts to improve relations with Israel, contrary to their public opinion, as well as dangerous positions regarding Iran have been amongst them (Davidson, 2012: 231).

3.4.2. Differences between the GCC and Iran

There are also significant differences in the GGC states' policies towards Iran that contributed, to a large extent, to the conflicts within the Council. So, apart from the positions of Kuwait and Bahrain, though for different reasons, vis–à–vis Iran, which are close to Riyadh's position, the other GCC states, comprising Oman, Qatar and the United Arab Emirates, have taken a more independent stance, while the latter is home to 400,000 Iranians and also 10,000 registered Iranian–owned companies (Aarts & Duijne, 2009: 69) and large number of Iranian–origin population live in other GCC countries (Davidson, 2012: 172 & 173).

The main mutual controversial issues have been regarding Iran's nuclear programme, its regional activities, followed by conflicts concerning the ownership of the triple islands of Abu Musa, Greater and Lesser Tunb with the United Arab Emirates.

However, some harsh stances against Iran by some GCC member states have been against public opinion inside these countries (Davidson, 2012: 231).

3.4.2.1. Regional penetration

Some Arab Sheikdoms view non–Arab Iran's growing role in the region, in particular in Iraq, Syria and Lebanon as a security threat (Gause, 2005: 273) and they even believe that Obama's policies towards Iran in recent years, have led to increase the GCC countries' sense of vulnerability in relation to Iran based on the view that Iranians' loss is Arabs' gain (Oktav, 2011: 139).

Tehran, on the other hand, believes that the main impediment against the regional stability relates to ultra–regional power(s), as this presence has produced an anti–Iranian alliance that prevented normalisation of relations with a score of Sheikdoms and creation of a "Gulfisation order" (Fürtig, 2007: 629) by the reduction of dependence on foreigners.

3.4.2.2. Iran's nuclear issue

Energy diversification is a major policy that the regional countries have pursued, more or less, and taken steps towards achieving sustainable security and economic development in the region (Barzegar, 2010: 82–83) and nuclear energy has achieved a high position in this respect.

The "nuclearisaton of the GCC" (Davidson, 2012: 173) has started since February 2007, and the IAEA (International Atomic Energy Agency) agreed mutually to work together on a nuclear power plan (Broad & Sanger, 2007), and also establishment of a Uranium Enrichment International Consortium for the Middle East based in a neutral country outside the region, an initiative also vigorously supported by the EU (Shenna, 2010: 11). This had been previously proposed by Iran.

The Emirates Nuclear Energy Corporation (ENEC) and Bahrain, furthermore, signed certain nuclear energy cooperation agreements with France and the US in 2008 and the former country is to construct four nuclear reactors with South Korea.

However, there is not any unified "Gulf perspective" on the Iranian nuclear issue. So, Kuwait, Qatar, and Oman are more tolerant of the Iranian nuclear programme (Shenna, 2010) and recognised Tehran's legitimate rights for making use of peaceful nuclear energy (Barzegar, at: fa.merc.ir), while the United Arab Emirates has been extremely cautious regarding Iran's nuclear programme (Davidson, 2010 b: 100).

Some of these Arab states expressed their concerns over Iran's nuclear issues environmentally, ecologically and especially militarily. Nevertheless, after the Tehran Nuclear Disarmament Conference on 17th and 18th April, 2010, Iran, more strongly, insisted that the use of nuclear weapons is religiously banned.

On the other hand, the lack of GCC involvement in the negotiations over Iran's nuclear programme (El–Hokayem and Legrenzi, 2006: 8) and scarcity of mutual confidence between the core and periphery parts (Gause, 2005: 272) have hampered progress toward the cooperation between the core, periphery and even with intrusive player(s), which has lagged behind the economic interdependence (Ulrichsen, 2009: 41–42).

Despite these disagreements, all six GCC states maintain extensive tourism and trading links with Tehran. So, ties of trade and shared commercial interests provide a powerful justification for improving relations between the GCC and

Iran on the basis of regional interests, for instance, in a stable and peaceful Iraq, as well as energy (RAND, 2009: 36–38). This became evident after Qatar's decision to invite the Iranian President to the GCC Summit in Doha in December 2007.

3.5. The current security model in the Persian Gulf

International politics could be described with reference to three arenas: the globe, the region, and the nation–states. These might be represented as the dominant, subordinate and internal political systems. Therefore, our conceptual framework for the Persian Gulf region is situated in the second category.

Since the 1990s, the Arab Persian Gulf states and Iran have been sporadically discussing security arrangements to ensure the stability of the region and also a secure energy supply. However, some factors such as the lack of unified leadership in the GCC (Oktav, 2011: 139) and a couple of problems between Iran and also Iraq with the Sheikhdoms, especially lack of mutual trust (Davidson, 2012: 142) have hindered the restoration of more cooperation.

Since 2003 and the after fall of Saddam in Iraq, the tensions in the Persian Gulf have become more evident, increasing the divergent interests of Iran and the GCC countries, although, the situations in the area since the start of 2011 have been complicated, particularly after another round of sanctions against Iran in December of that year.

They have not been able to restore mutual trust, mostly due to two factors:

- ✓ The US policy of containing Iran;
- ✓ Iran's insistence on being a nuclear power.

These two factors drive the Persian Gulf monarchies to continue relying on outsiders, on the basis of the balance of power (Oktav, 2011: 140) as they are vulnerable, given to the close proximity to major conflicts, certain potential threats and small populations, except Saudi Arabia to some extent (Davidson, 2010a: 20).

However, their reliance on a "Western security umbrella", particularly the US, is problematic, "given the strained relations between the Arab world and the US", due to the Arab–Israeli conflict, in addition to the invasions of Iraq and Afghanistan (Davidson, 2012).

These situations could place the GCC countries at "the frontline of any fresh conflict in the region and lead to undermine the current generation of these rulers" (Davidson, 2012: 172 & 173).

In summary, the scarcity of unified threat perception, different approaches within the GCC (Ulrichsen, 2009: 43), territorial and long–running disputes(Davidson, 2012: 231) within the region, politicisation and securitisation of the Persian Gulf and probable commitments to other ultra–region bodies and organizations, such as Organization of the Petroleum Exporting Countries (OPEC) and Economic Cooperation Organization (ECO) (Oktav, 2011:144) could be considered as the main obstacles against more regional cooperation, particularly between the core and periphery sections.

3.6. The appropriate security model for the Persian Gulf

Security and stability in the Persian Gulf has been more important not only for all regional states, but also for the international system, while the mentioned region with the world's largest hydrocarbon reserves has played a growing central role within the Middle East, as well as global politics (Davidson, 2011: 1).

In addition, most of Iran's foreign incomes and also Arab's petrodollars (Ehteshami, 2003) are obtained from the export of energy through the Persian Gulf, as a main route of its international trade and communication.

Amongst the number of high–profile experts, Gal Luft (annex 1), believes (2011) that the role of the Persian Gulf core and periphery states in energy supply will be most important, and new global energy geo–politics should be portrayed, considering the new energy map in the Persian Gulf region regarding Iran (see in the Chapters 2&5).

Paul Rogers (annex 1) in "Iran and the International System" Conference, which took place at Durham University on 7th June 2009, argued that the global geo–politics, geo–strategic and geo–economic positions of the Persian Gulf countries, in particular Iran, will be more significant in the future as demand for hydrocarbons increase.

Any economic diversification in the region, and foreign investments required a stable regional environment (Seznec, 2010: 11) by interdependent relationship (Aarts & Duijne, 2009: 73), as any instability in the region would hinder the flow of foreign direct investment to the Persian Gulf countries (Seznec, 2010: 11). Most notably, Arab Sheikdoms have been trying to improve the investment risk within their countries, so they have dramatically succeeded in promoting their positions in the global ranking, while the United Arab Emirates, Oman, Qatar and Saudi Arabia have enjoyed very low risk in investments and the two former states have stood amongst the top 10 countries in the world in terms of the best situation for venture in 2012 (Chapter 5). It shows that despite less stability within the Persian Gulf, these Arab countries could promote investment conditions domestically, and the periphery could also do likewise.

In a region where "hydrocarbon is king and security is risky" (E. Wiegand, 2012: 95), the reliance on oil and gas supply from the Persian Gulf will increase in the coming years and even decades, while the littoral countries, indeed, have a structure of "mono–base economies", based on oil and gas exports, over 90% of regional exports (Naji & Jawan, 2011: 2). This shows that the energy security of both the exporters and importers is affected by stability, less stability or instability in the region. So, the continuation of the Iraq crisis, the American–Iranian situation and the current mutual approach between Tehran and some monarchies could lead to more regional instability.

Accordingly, the new political and security structure of the Persian Gulf region should be redefined (Kemp, 2012, Durham University) according to the new developments occurring after the Baath Party era in Iraq, Iran's role (Armitage & Nye, 2007), development outside the region (Maloney, 2010: 45), as well as the Arab spring that have led to political developments in the Middle East and

North Africa. While the political landscape becomes more diverse than ever, the external actors, such as the EU, need a new approach (Bauer, 2011).

Obviously, the regional order has become more vulnerable due to lack of collective security and basic unity in the six monarchies (Davidson, 2012: 231), the volatile relations between the GCC and Iran (Ulrichsen, 2009: 41) and it seems that most of the dilemmas mentioned in the Persian Gulf region are partly related to separation of the core and the periphery players, so the systematic coherence, interdependence, and vital belief to regional cooperation have not been observed (Ghasemi & Salehi, 2008: 70–72).

First of all, the GCC, as a core and "de facto security alliance" (M. Pollack, 2012: 3), needs to find a practical balance between dependence on the US, as an external security guarantor, and the creation of a regional comprehensive and cooperative security system (Ulrichsen, 2009: 53), like the Organization for Security and Cooperation in Europe, that can provide greater stability, by Iran and also post–occupation Iraq's involvement, as the peripheral states in the region, than the balance of power system has done so far (M. Pollack, 2012: 2). This new regional model could be entitled, the so–called "GCC+2" that Iran also proposed such as the kind of regional alliance with Arab states alongside Baghdad. However, Saudi Arabia and Iraq, in Pahlavi's era opposed this suggestion (Mojtahed Zadeh, 2010: 240).

Therefore, realistic solutions would be required toward the interests of all regional and even extra–regional players (Khalil , 2007), by the substituting of "balance of interests" in the current balance of power amongst the core and peripheral states, as well as international players (Oktav, 2011:145).

Consequently, while the presence of some Western powers within the Persian Gulf, in addition to competition between the core and periphery from one side, as well as between the peripheral Iran and intrusive player(s) on the other side, have complicated the security dilemma, by "increasing economic interdependency", similar to what happened between the Persian Gulf's coastal states with a number of Asia–Pacific countries, regional current situations could be desecuritised further (Davidson, 2010 b: 109), whereas from the geo–politics of energy perspective, this area is the joint axis of three most important economic regions in the world, comprising the US, the EU and Asia pacific (Naji & Jawan, 2011: 2). So, the Persian Gulf littoral states, particularly the GCC's "eastward orientation" (Davidson, 2011 b: 183) could be expanded to the westward direction by the "GCC+2".

The Persian Gulf Emirates are keenly aware of the economic benefits of a pragmatic relationship with Iran (Burke & Bazoobandi, 2010: 8) and it is obvious that the five smaller GCC states enjoy such a relationship with the country, more or less. Saudi Arabia, meanwhile, perceives itself to be in a strategic and political contest with Iran in the region that has greatly affected trade between Riyadh and Tehran.

As a result, considering the common Islamic culture without any discrimination regarding Sunni and Shia (Davidson, 2012: 231), interdependent relations on different economic, particularly energy, and political strategic aspects could be developed in line with regional interests (Özden Zeynep, 2011: 145), while some policies in the framework of the balance of power system, such as the dual containment strategy, sanctions against regional players, and the theory of the axis of evil would seem to work against these countries' interests and would be a "lose–lose" game.

Of course, this regional interdependence should be commenced "by changing the political boundaries to economic" in order to produce governance of peace and stability in the region (Zein–al–abedin: 2007) and then it could extend to comparative cooperation with confidence–building between the core–periphery, especially Iran, simultaneous with Tehran–intrusive player(s), particularly the US, bilaterally.

So, this tendency should be based on a non–zero sum game and détente regionally, even with foreign powers, in conjunction with more bargaining rather than confrontation (Ghasemi & Salehi, 2008: 74–76).

The powers of intervention have political and strategic, as well as economic interests in regional peace and stability, while, given the strained relations between Tehran and Western powers, GCC could be in a position to serve as a facilitator in the conflict over the Iranian nuclear programme (Bauer et al. 2011).

According to Prof. Geoffrey Kemp on 13th September 2012 at Durham University, "Washington could not do its commitments regarding the (Persian) Gulf security, unless negotiating even with its adversaries and rivals". He added that the external powers, especially the US, should redefine their strategic and security presence in the region alongside the realistic relations with the littoral states.

To sum up, the balance of interests arrangement in the Persian Gulf requires a couple of considerations, on the basis of:

- ✓ Confidence–building amongst Iran, GCC, and intrusive players (Davidson, 2012.);
- ✓ Common political and security threats;
- ✓ Focus on commonalities, like economic and energy instead of differences, such as Shia and Sunni ideologies (Özden Zeynep, 2011);
- ✓ Participation of all regional and trans–regional actors and their interactions with the special role for each player in the region's new security architecture (Barzegar,2010: 74);
- ✓ Regional economic interdependence (Davidson, 2010 b: 109) that could lead to a common market, extension of pipelines, and establishment of a joint shipping lines.

As a result of this new approach, the security of supply from the Persian Gulf countries could be raised further (Fattouh, 2007: 24).

Indeed, hydrocarbon, as a clear example of interdependence between the exporters and importers (Pascual & Elkind, 2010: 4), plays an important role not only for Persian Gulf littoral states' energy security, but for other importers, such as the EU. As a result, insecurity in the Persian Gulf or disruption in energy supply from this waterway, even for a short period of time, could threaten the developed and newly– emerging economies and this region's energy security, multilaterally.

Therefore, balance of interests and security amongst the core, periphery states and also intrusive players, instead of balance of power, can ensure the Persian Gulf regional energy security and supply towards the EU, mutually.

3.7. Conclusion

Oil exploration within the Persian Gulf and gas commercial supply from this geo–strategic region has greatly strengthened its geo–economic features. Energy, moreover, has caused more attention to be paid to this area by the great powers during recent periods and has also impacted on delineation and, most significant of all, territorial disputes.

By withdrawal of the British armed forces from the region, the US replaced it as the main intrusive player, while the Islamic revolution in Iran in 1979, followed by the Iran–Iraq war in 1980, the regional status quo changed. These developments led to creation of the GCC in 1981 and divided the region in three sections, comprising the GCC, as the core, non–GCC Arab Iraq alongside non–Arab Iran, as the periphery, as well as the powers of intervention.

So, the consequences of this balance of power and mistrust have been conflict and competition, mostly between the GCC and Iran, in addition to the US and the mentioned country, rather than more cooperation. Tehran's alleged penetrations and its increasing regional role alongside its nuclear programme have been the major controversial issues with regional and ultra–regional players.

Nonetheless, security and stability in the Persian Gulf, with the world's largest hydrocarbon reserves, are more important not only for all regional states with a structure, but also for the international system.

The reliance of natural gas and LNG supply from the Persian Gulf will increase in the coming years and even decades (see Chapter 5 and Final Conclusion), while littoral countries have the structure, of mono–base economies, based on oil and gas exports.

Obviously, the energy security of both exporters and importers is affected by stability, less stability or instability in the region. So, the ongoing crisis in Iraq, the American–Iranian situation and the current mutual disputes between Tehran and some monarchies could lead to more regional instability.

Accordingly, the new political and security structure of the Persian Gulf region should be redefined according to new developments after the Baath Party era in Iraq, Iran's role, as well as the Arab spring.

Apparently, most of the regional problems are related to the separation of the core and the periphery players, instead of interdependence. However, by Iran's and also post–occupation Iraq's increased involvement, the new regional model could be formed, entitled "GCC+2". In such a system, the balance of interests, as the non–zero sum or "win–win" game is replaced in the current balance of power of the zero sum or "lose–lose" game.

The GCC needs to find a balance between dependence on the US, while the regional interdependence should be aided by changing the political boundaries to economic for more regional peace and stability in the region.

This has been the GCC's "eastward orientation" towards a number of Asia–Pacific countries whilst the westward approach could be expanded by the "GCC+2", based on confidence–building and détente between the core–periphery, especially Iran, concurrent with Tehran–intrusive player(s), particularly the US, that could lead to more bargaining rather than confrontation. Under these circumstances, the "EU–[GCC+2]" model would take shape, as it will be discussed further in chapter 6.

For security in this region, there are several possible methods, such as military treaties between regional countries or the military presence of foreign countries in line with the balance of power, but historical evidence has shown that none of them could guarantee stability and security in this region. Therefore, regional cooperation in the form of economic and energy cooperation, in the so–called "GCC+2", can increase the coefficient of security stability in the Persian Gulf region, leading to the rise of global energy security as well. Construction of gas transmission lines between countries in the region and more cooperation for LNG supply are the kinds of regional collaboration that can be an alternative to military treaties.

Hydrocarbon could be assumed to be a main element for interdependence between the exporters and importers and plays an important role in theirenergy security. As a result, insecurity in the Persian Gulf or disruption in energy supply could threaten regional and global energy security.

Chapter 4: Geo–politics of natural gas within the Persian Gulf and two case studies

4.1. Introduction

Natural gas is the world's fastest growing fossil resource and the Middle East holds 40% of global reserves, while nearly the whole of these deposits are situated in the Persian Gulf, as the gas–richest area worldwide. Iran and Qatar embrace nearly 30% global natural gas or 75% of Middle East gas reserves and these two alongside more four littoral states in the region are among the top 20 gas holders worldwide. Consequently, natural gas and LNG production and export from Middle East/Persian Gulf, especially Iran and Qatar will increase more than other parts of the world by 2030, while in conjunction with the dramatic increase in the demand for natural gas and LNG in the future, 50% worldwide and up to 90% in the EU, most of the global gas reserves will reduce or could even run out by the next decade. So, the minor producers could cease to produce, and the role of the major gas producers from conventional gas and unconventional gas will highlight further.

The Persian Gulf, however, has some challenges in order to develop its natural gas and LNG industries appropriately and to export more during the coming years, such as unconventional gas produced by the US, the increase of LNG exported by Australia, as the main competitor for Persian Gulf, high domestic gas demands, regional political instability, inadequate international investment, and energy inefficiency.

Based on Iran's "20–Year Outlook Document (2005–2025)", followed by "Iran's Grand Energy Strategy by 2023", this country plans to increase its existing 1% share of gas global market to 8%–10% by 2023 and takes part in GECF more actively, so LNG projects will play an important role in this regard. Tehran has some LNG facilities under consideration and under construction and plans to be among the top five global exporters by 2020. However, foreign sanctions as well as high domestic consumption are the main impediments against achieving this target. As a result, there are three main scenarios regarding these two principal obstacles against Iran's piped gasand LNG projects and exports.

Qatar's "Gas Strategy" emerged in order to shift from oil to natural gas, basically LNG, leading to the construction of 14 trains, with 77 Mmt/y export, resulting in its becoming the leading LNG exporter worldwide. Qatar's economic and domestic growth, on the other hand, has accelerated and demand for energy more than doubled since 2000, and will continue to increase in the future. Because this country is the fourth largest gas consumer in the Middle East/Persian Gulf, it is attempting to put an end to the enormous subsidisation of local energy prices and aim for more conservation while increasing use for natural gas, based on "Qatar's National Vision 2030 Document". Some predict that Doha might have some problems in the future in attempting to increase its exports, while some officials are of the view that this country should decide not to build any more LNG facilities in years to come. The others also believe the country could increase its current export capacity to preserve its global position against other competitors.

On the topic of GECF, this intergovernmental organization might play an important role in the globalised gas market while Iran's, Russia's and Qatar's positions and coordination, as the three top global gas holders in this body, with 54% of the global gas deposits, are influential. However, this forum raised concerns with many importers over the possibility of the emergence of a Gas–OPEC. This forum also faces some challenges on its way to becoming more powerful, including different views among the members, a high number of the existing members, new unconventional gas holders outside this organization, duel membership of some countries in both GECF and OPEC, as well as energy market liberalization and development of renewable energy sources in the future.

So, in this chapter, the subsequent questions are considered more:

- Given the production of gas from unconventional gas, as well as new competitors for Persian Gulf, such as the US, Canada, and Australia, and also Persian Gulf domestic consumption, what is the position of the littoral states, particularly Iran and Qatar in the global gas market in the future?

- How could Iran handle the main impediments against its Energy Outlook aims to increase its natural gas and LNG exports by 2023, and how many scenarios there are in this respect?
- As Qatar is the leading LNG producer worldwide for the time being, what is this country's gas outlook in the years to come, and also its LNG export plans?
- How could the GECF impact on the global gas market, with consideration to Iran's and Qatar's positions in this body?

4.2. Geo–politics of natural gas in the Persian Gulf

Natural gas is the world's fastest growing fossil fuel in many regions, particularly in the electric power and industrial sectors because of its low capital costs, thermal efficiencies, environmental attraction compared with coal and oil, significant price discount compared with oil in many world regions, and based on governments' policies to reduce greenhouse gas emissions (EIA International Energy Outlook 2011: 43).

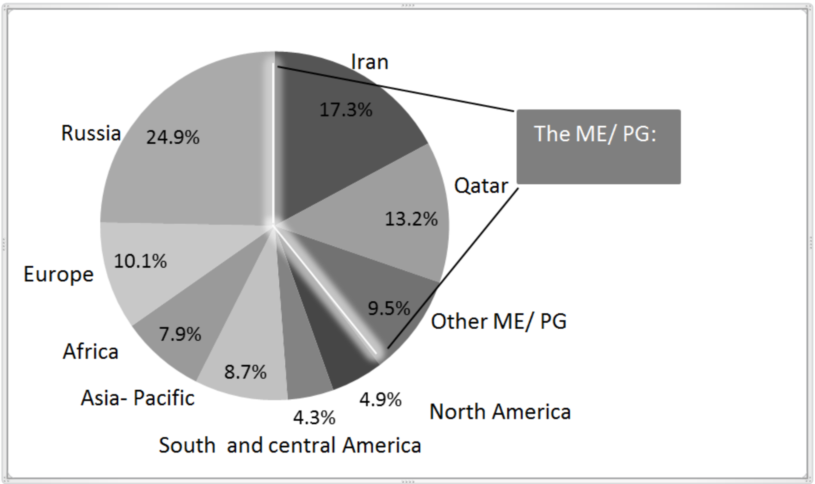
According to the Oil and Gas Journal in January 2012, the world's gas reserves at the beginning of 2012 were 3,330,137 bcf (table 21).

The Persian Gulf region, as having the most important natural gas deposits within Middle East and North Africa, holds an estimated 2,400 tcf of natural gas reserves (EIA International Energy Outlook 2011: 33) or 76.16 tcm (BP Statistical Review of World Energy, June 2011), situated in this region and five of its countries out of eight, are within the top 15 gas holders worldwide (table 21), while according to some international energy organizations, there is the likelihood that some more gas reserves would be discovered in the future within the Persian Gulf region, while Iran's proved reserves increased from 1,045,670 bcf in 2011, 15.7% of global deposits, to 1,168,000 bcf in January 2012, 17.3% of the world's reserves.

Qatar has, however witnessed a decline from 895,800 bcf in 2011, 13.5% of total deposits worldwide, to 890,000 bcf in January 2012, 13.3% of the world's reserves Other Persian Gulf states, more or less, have had such this increase, such as Saudi Arabia (table 21).

According to BP (BP Statistical Review of World Energy, June 2011; BP, 2010: 22), Middle East and North Africa holds roughly 48% of global natural gas reserves and 40% of these reserves are situated in the Middle East/Persian Gulf, nevertheless, based on map 1, roughly a total of 40% of Middle East's gas reserves are located in the Persian Gulf region (figure 41).

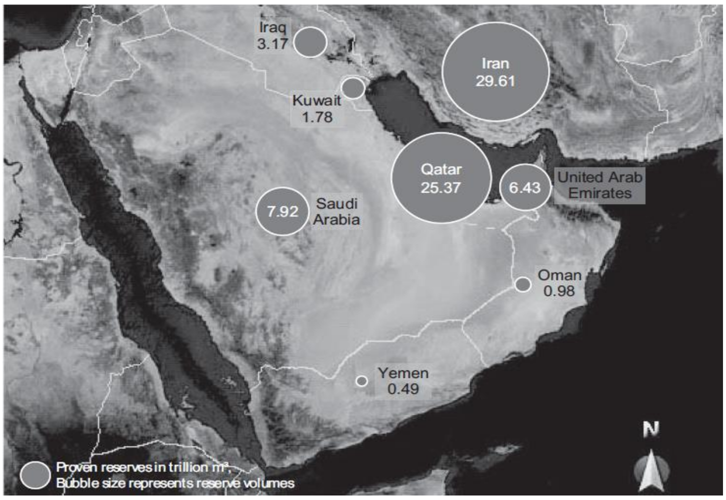
Figure 41: Distribution of proven natural gas reserves in the world



Source: By Author, based on Oil and Gas Journal, Jan 1, 2012, USGS, EIA International Energy Outlook 2011: 64 (see Chapter 6).

So, the natural gas reserves within the Persian Gulf differ widely from one country to another, from a low of 0.90 tcm and 0.98 tcm in Bahrain and Oman respectively; to a huge amount of 29.61 tcm and 25.37 tcm in Iran and Qatar respectively (map 6). Furthermore, 61% of the region's natural gas is situated in a single giant field shared between Qatar and Iran that is known as the North Field in Qatar and the South Pars in Iran, as the world's largest non–associated natural gas field. That leaves these two for the expanding non–associated gas output and export.

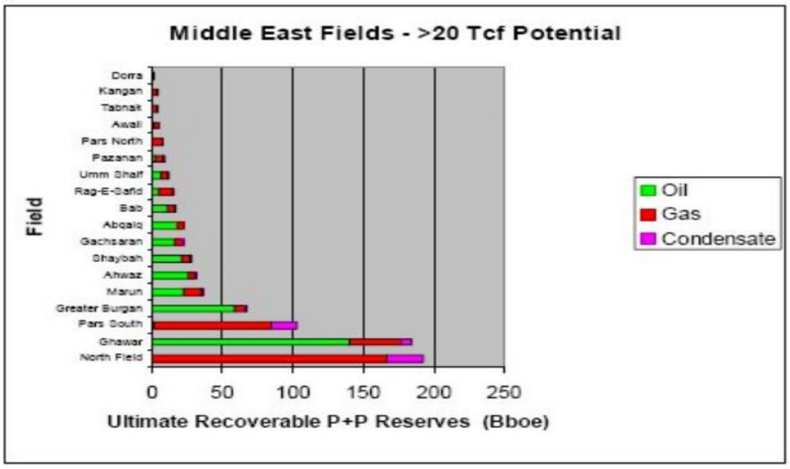
Map 6: Proven natural gas reserves in the Middle East/Persian Gulf (tcm)



Source: M. Wietfeld, 2011: 206 (based on BP Statistical Review of World Energy, June 2010 and 2011)

However, most of the proven natural gas reserves in the GCC, with the exception of those found in Qatar, are in associated form together with oil that leaves, in the GCC, only Qatar with a huge scope for expanding gas output and export (Abi–Aad, 2009: 6).

Figure 42: Non–associated and associated giant gas field within the Middle East/Persian Gulf



Source: http://www.theoildrum.com/story/2006/6/8/155013/7696

4.2.1 Unconventional gas as a rival for Persian Gulf's conventional gas

Most of the gas reserves worldwide, including Latin America and sub–Saharan Africa are relatively small compared with the Persian Gulf states' and will reduce in a number of years to come, so after that the Persian Gulf's natural gas reserves will be more strategic than ever (Rogers, 2012: 168–174).

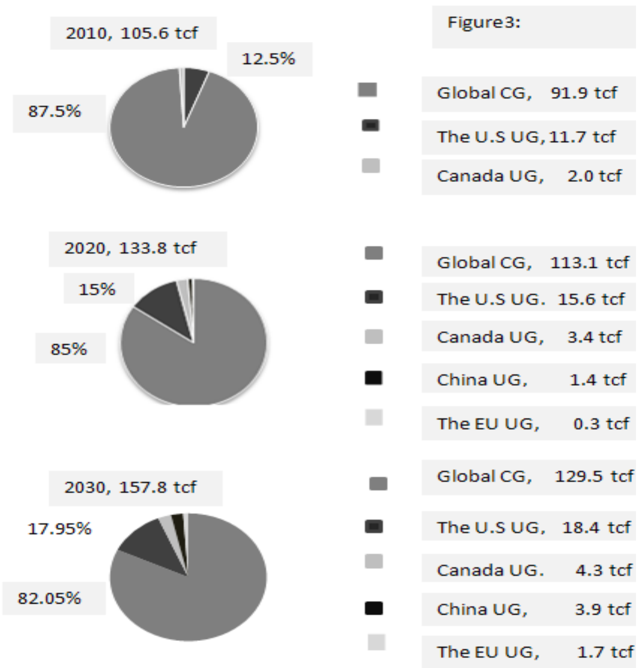
According to BP (BP Statistical Review of World Energy, June 2011), while global gas production was 2413.4 bcm/around 86.86 tfc and 3193 bcm/roughly 115 tcf, in 2000 and 2010 respectively, and gas production rose 7.3% more than 2009 (annex 6), some predict (US EIA 2011: 50) that these numbers will increase to 133.8 tcf and 168 tcf by 2020 and 2030, while some regions, like Europe, will be faced with a fall of reserves and production (annex 7). An increasing amount of gas, therefore, will be produced at locations more remote to the centres of demand and transported to consumers (Lochner & Bothe, 2009: 1518–1528) and, according to IEA (IEA, 2007: 86), 50% of natural gas demands until 2030 will originate for power plants.

Most of the gas production increase in OECD countries will be allocated to the US, Canada, and Australia (annexes 6&7). The US will progress in unconventional gas as the "game changer" (Bahgat, 2012), including shale and tight gas, as well as coal–bed methane from 10.9 tcf in 2008 to 19.8 tcf in 2035, and more than 75% of this country's gas production will be unconventional gas (US EIA, 2011: 50; Skagen, 2010) and with this breakthrough, the OECD Americas region would be relatively self–sufficient by 2035 (US EIA 2011: 58) and even "many European companies are making progress to apply UG in Europe during the next decade" (Bahgat, interview), but slightly (US EIA 2011: 50). On this basis, the "unconventional gas revolution" (IGU World LNG Report, 2010: 23) or "energy revolution", according to Dr. Christopher Davidson in the workshop being held at Durham University on 27th November 2012, could reshape the LNG system, providing that the US will no longer need to import LNG over the coming decades, and other countries could replicate the experience of the US (IGU World LNG Report, 2010: 9). However, unconventional gas faces some constraints, such as environmental (US EIA 2011: 53), financial (S.A. Gabriel et al. 2012: 137–152), ecological and infrastructure (Ying N, 2012); nevertheless, apart from these restrictions, production of unconventional gas will grow from 13 tcf in 2008 to 31 tcf in 2035, in particular in the US and Canada and non–OECD Russia and China (figure 62 & annex 7).

In spite of the fact that some of the energy experts count the unconventional gas as a serious rival for conventional gas during the two next decades, particularly in the North America–OECD, it could be argued that at least over the same period of time, conventional gas preserves its supremacy on the global gas market.

Analysis of the different official data issued by international organizations, including BP Statistical Review of World Energy, June 2011 (annex 6), EIA International Energy Outlook 2011, Oil and Energy Trends in January 2012,and IEA World Energy Outlook in 2008, illustrates that the percentage of unconventional gas compared to conventional gas in global gas production will be under 18% by 2030, while this number was 12.5% in 2010 and will be 15% in 2020 and then will increase to 17.95% by 2030 (figures 43 & 44).

Figure 43: Comparison of unconventional gas and conventional gas by region/country, 2010–2030



Source: by Author

Moreover, more than 85% of unconventional gas in 2009 and 75% in 2030 devotes to the US, as the leading producer and also more than 92% production allocates to this country alongside Canada. For this reason, the US will preserve its second global gas producer position, after Russia, by 2030, though Iran and

Qatar will replace Asia since the second half of the current decade and keep significant production even after 2030.

In addition, whereas the US increases its unconventional gas in the future, but it will be the leading gas consumer worldwide by 2030 and the whole of Europe will follow the US by the next two decades (table 16).

Table 16: The main gas producers and consumers by country/region, 2010–2030

Production			consumption		
The 2010s	**The 2020s**	**The 2030s**	**The 2010s**	**The 2020s**	**The 2030s**
United States	Russia	Russia	United States	United States	United States
Russia	Asia-Pacific	Persian Gulf	Europe	Europe	Asia-Pacific
Asia-Pacific	Persian Gulf	United States	Asia-Pacific	Asia-Pacific	Europe
Persian Gulf	United States	Asia-Pacific	Russia	Russia	Russia
Europe	Africa	Africa	Middle East	Middle East	Middle East
Other North America	Other North America	Other North America	FSU (except Russia)	FSU (except Russia)	FSU (except Russia)
Africa	Latin America	Latin America	Other North America	Other North America	Other North America
Latin America	FSU (except Russia)	FSU (except Russia)	Africa	Latin America	Latin America
FSU (except Russia)	Europe	Europe	Latin America	Africa	Africa

Source: by Author, on the basis of different official data, like BP Statistical Review of World Energy, June 2011 (annex 6 & 8, Chapter 2); The Baker Institute World Gas Trade Modes (BIWGTM) (Chapter 5); US EIA, International Energy Outlook 2011;

The table above also shows that Middle East/Persian Gulfwill move from the fourth top producer in the world during the 2020s to the main Russian competitor during the decade after that. This shows that while the North America's unconventional gas production raises, however, based on the official forecasts, it should mostly consume domestically (annexes 7, 9 &17). Therefore, unconventional gas will ensure 24% of gas demand in the US in 2035, up from 6% in 2008 (DOE–IEA, Annual Energy Outlook 2010: 3).

Some believe that by the US' becoming more self–sufficient in gas production, the previous volumes of gas exported to this country, will be directed to different countries and areas, but some others insist that global gas demand will dramatically increase at the same time, and attract even much more production.

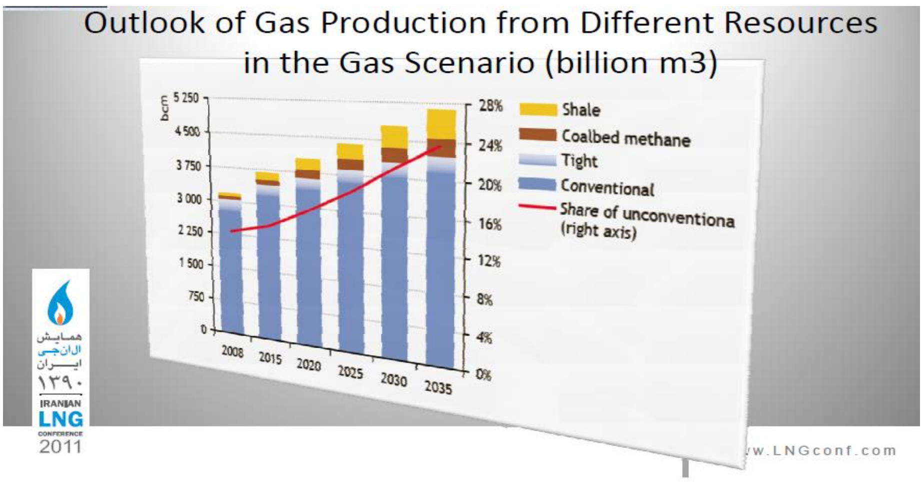
Natural gas production in Australia/New Zealand region doubles (EIA International Energy Outlook 2011: 50) and it might grow by triple (figure 4) (World Gas Intelligence, 2011:10) between 2008 to 2030 with the share of nearly 8% for unconventional gas and the CBM–to–LNG (US EIA 2011: 52). Hence, LNG exports from Oceania will increase by 2020 (World Gas Intelligence, 2011:10), and will be transported to China, India, and probably Europe (Oil & Energy Trends, 21.01.2011: 4), as well as Taiwan, Thailand, Japan and the Philippines (Oil & Energy Trends, 15.01.2010: 7). It might even overtake Qatar as the world's largest LNG producer at present (Sky News, 30.09.2011). On the other hand, domestic natural gasand LNG use within Oceania will also increase, based on governmental efforts to reduce greenhouse gases (EIA, International Energy Outlook 2011: 46) with the rate of annual growth of natural gas and LNG up to 12.6% over the next two decades (Robins, 2011).

CBM–to–LNG also would also raise a number of environmental difficulties (Oil & Energy Trends, 21.01.2011: 6) while the lack of the required $US 150 bn capital (Robins, 2011) to build a score of planned LNG export terminals by 2017 is another barrier against this country's LNG development.

However, concerns about the extensive use of expensive (Inkpen & H.Moffett, 2011: 6) hydraulic fracturing in order to carry out exploration of unconventional gas have been raised globally, especially by the public in the US because of the significant amount of water required, contamination of ground water, and other environmental risks (US EIA 2011: 53), resulting in restrictions on the issuing of drilling permits, especially in the State of New York. France has recently taken legislative action to ban hydraulic fracturing in that country (US EIA, 2011: 49) so, some argue, it is unlikely that the US will become the next Middle East, as infrastructure and ecological constraints will limit the country's ability to produce and export more LNG from unconventional gas (Ying N. 2012) while the natural gas "troika" composed of Russia, Iran, and Qatar could produce and export more gas at much cheaper cost to the global market even the US (S.A. Gabriel et al, 2012: 137–152).

Consequently, we can conclude (figures 43 & 44) from global official data that while the total amount of global conventional gas production would account for between 83%–87.5% between 2010–2030, production of unconventional gas increases from more than 12.5% to around 17% during the same period.

Figure 44: The balance of global conventional gas and unconventional gas production



Source: Iran's LNG Conference, Tehran, October 2011

4.2.2 Comparison of different regions within the World's natural gas and LNG outlook

Regarding Russia, it remains the dominant gas producer (US EIA, 2011: 54); however, the IEA stated that "Russian Gazprom could face a growing difficulty to meet its export contracts if it does not advance the agenda of investment in new fields" (IEA, 2006b: 34–35).

Natural gas production in Africa for domestic consumption and also export increases around 50% by 2020, while in 2008; almost 78% of Africa's gas was produced in North and West Africa (US EIA, 2011: 55) and nearly 75% of exports flow to the European countries, such as Spain, Italy by pipeline, and LNG shipment (50%–50%) (Davidson, 2012:62).

Apart from Norway, gas production in OECD Europe has been in decline (US EIA, 2011: 51) while Malaysia and Indonesia, both face declining production from many older fields and must make more investment to maintain current production levels (Davidson, 2012.: 56), although Indonesia has at least 20 active production–sharing contracts for coal–bed methane drilling (CEDIGAZ, 2010: 2).

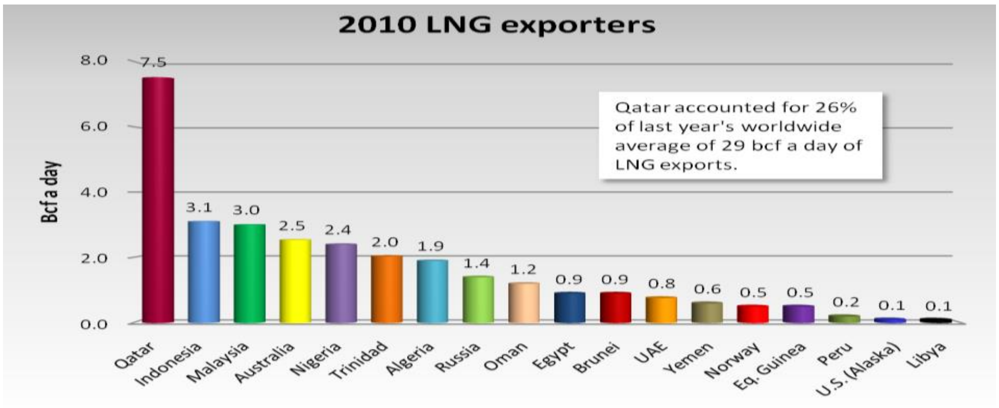
In summary, the largest changes in increasing production from 2008 to 2035, based on figure 44, are projected for the Middle East/Persian Gulf, particularly originating from Iran and Qatar by a combined one–fifth of the total growth in world's gas production (EIA International Energy Outlook 2011: 43) and also the US' production change will be to the fifth position out of nine.

The Middle East/Persian Gulf and the Commonwealth Independent States (CIS) regions are the most important gas exporters to different regions and countries in order to create a more globalised gas market, while African suppliers only serve Europe and the US and also Pacific Basin supplies its LNG only to the US and the Far East markets (Lochner & Bothe, 2009: 1518–1528).

Natural gas trade and LNG shipments grew by 10.1%, as well as 22.6% in 2010 and in 2011, while the global LNG trade grew more than 50% in 2010, compared to 2005 (BP Statistical Review of World Energy, June 2011: 29; IGU World LNG Report, 2010: 4&5), so that the global LNG capacity has been increased, from approximately 176 Mmt/y at the end of 2005 to 260 Mmt/y at the end of 2010, with a 40% increase and final LNG consumption was 10.4 tcf in 2010 (CEDIGAZ, 2011: 15). Consequently, based on statistics, global LNG capacity will nearly double by 2030 (US EIA, 2011: 44).

The LNG trade has not only grown in volume, but geographically increased from 13 exporters in 2005 to 18 in 2010, however roughly 80% of global LNG is transmitted by the 8 top exporters (figure 45).

Figure 45: The top LNG exporters in 2010



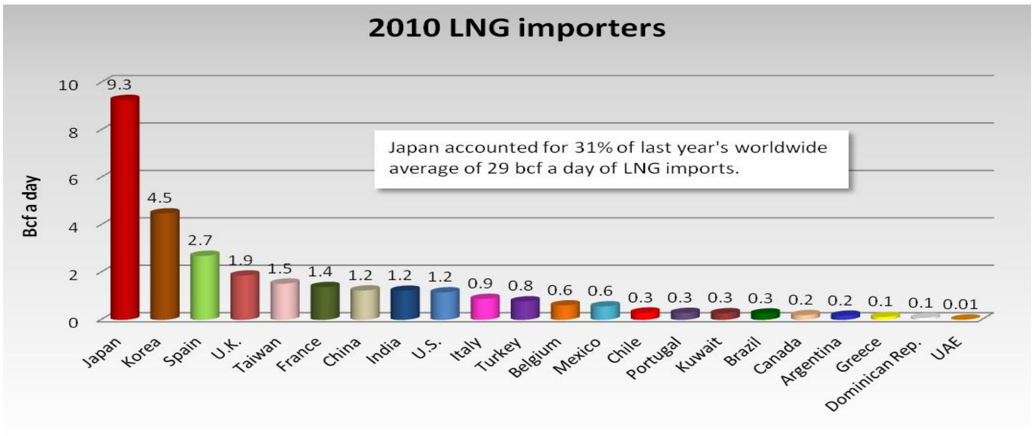
Source: IGU, World LNG Report, 2010

On the other hand, 80% of global LNG imports, belonged to the top 10 importers, while Spain, the UK, France and Italy, as the Author' s four case studies within the EU, together imported 25% of the world' s LNG exports, and this region is set to diversify its gas import routes away from piped Russian gas (White, 2011).

So, the number of importers from 2005 to 2010 grew around 200% to 22 (figure 46), just the US decreased its LNG import during 2005 to 2010 due to the domestic supply from unconventional gas (IGU World LNG Report, 2010: 8) and there are some predictions that because of shipping technology improvements, leading to a fall in transport costs (S.A. Gabriel et al. 2012: 137–152), LNG exports will increase in the near–term, particularly to South–east and non–OECD Asia, as well as the EU (IGU World LNG Report, 2010: 9)while Europe's LNG regasification capacity has almost tripled in just 6 years (CEDIGAS, Statistical Database).

Most of the increase in liquefaction capacity is in the Middle East/Persian Gulf and Australia, (US EIA 2011: 44) so that, net exports of NG from the Middle East/Persian Gulf grows from 1.8 tcf in 2008 to 4.8 tcf in 2035 (Oil and Gas Journal, 7th March 2011: 4). As a result, according to Malcolm Wicks, the UK's ex–Energy Minister, Middle East/Persian Gulf is expected to become the greatest gas exporters by 2030 (Wicks, 2009: 35).

Figure 46: The top LNG importers in 2010



Source: IGU, World LNG Report, 2010

Since 2005, annual LNG send–out capacity has increased by 70%, reaching over 572 MMtpa at the end of 2010 and an additional 110 MMtpa is under construction in 30 countries. By 2015, when these facilities would be online, the global regasification capacity will increase to 680 MMtpa and the growth of global LNG receiving capacity is expected to continue on a strong path (IGU, 2010: 25–35) whereas, at least 29 more countries, the most belongs to Europe with 11, have some planned LNG terminals (Davidson, 2012.: 29).

Global gas consumption, moreover, will increase, especially in the US, as the top global largest gas consumer, and with Canada, the both hold 60% of the total increase for OECD countries (US EIA 2011: 44; IEA 2007), followed by the EU, Russia, non–OECD Asia (BP Statistical Review of World Energy, 2011: 4) from 111 tcf in 2008 to 133 tcf and 168 tcf by 2020 and 2030, so in order to meet this demand, the world's gas producers will need to increase supplies by almost 50%, and the biggest increase in supply is expected to come from non–OECD countries (Davidson, 2012.: 49), so the demand and supply factors impact on gas price volatility and on the supply side, the current suppliers have limited ability to expand their production in short and mid–terms (Pascual & Zambetakis, 2010: 12).

As a result, some new natural gas exporters must be added in the future in order to fulfill the demand–supply gap (BP Statistical Review of World Energy, June

2011), especially from the gas–rich Persian Gulf region (US EIA 2011: 43) with its geo–political position, enormous gas reserves, the least expensive cost extraction, and to some extent transportation.

4.2.3. Persian Gulf, as the least expensive and largest natural gas region

Generally, field size and its geographical location have the largest impacts on extraction costs (table 22). Thus, the lowest production costs can be observed in large onshore gas fields, the highest in smaller off–shore fields in deeper waters. So, according to table 23, Iran and Qatar have the cheapest production costs, in total, amongst other gas holders all over the world (Lochner & Bothe 2009: 1518–1528), but their transportation cost is a bit more than a number of exporters, depending on the destinations (figure 67).

Simultaneous with the declining of gas fields, is the timing of government decisions to provide more stable investment in order to develop new ones to meet growing demands with the lowest cost (Bahgat, 2011:13–14) as discovering new gas reserves is the lifeblood of the industry, otherwise the industry would die (Inkpen & H. Moffett, 2011: 5) so, low gas price is always a complex issue (Inkpen & H. Moffett, 2011: 71).

In two interviews on 4th and 14th March 2012, Peimani (annex 1) and also Howard Rogers (annex 1) argued that the investment within the Persian Gulf gas reserves is the least expensive compared with other areas worldwide, so the final gas price would be cheaper for importers, like the EU.

However, Anne Korine (annex 1), in an email communication on 5th March 2012, argues that despite abundant natural gas deposits in Iran and Qatar and the low cost to gas producers, however, “we cannot be certain the cost to gas consumers will be low as well, such as Saudi oil are $2 a barrel, yet the spot price is above $100”.

The LNG market has been tightening since 2010 as a result of the greater demand for LNG in Japan in the aftermath of the disaster at Fukushima Daiichi, political unrest in some Arab countries in North Africa (Kitasei, 2012), recovering of the global economy after recession in 2009, growing requirements in Europe (IGU World LNG Report, 2010: 29; US EIA 2011: 47) and LNG markets likely to need additional liquefaction capacity until and after 2015 to fill the gap between liquefaction and regasification capacities (IGU, 2010: 35), making the security of fresh gas supplies once again a top priority. If the global economy grows by an average of 2.5% a year from 2010 to 2015 (IEA, 2009: 365 & 425) so, the price of hydrocarbon, particularly natural gas is significant, for this reason the importance of a cheap gas holder, like Iran, is twofold in the coming years (Rogers, 2012: 168–174).

With 40% of the world's proven natural gas reserves, the Middle East and particularly the Persian Gulf region accounts for the largest increase in regional gas production, while more than 55% of Middle East gas production belongs to Iran and Qatar (annexes 6, 7&16) and both are the top two gas producers in the Middle East/Persian Gulf by 2035 (US EIA 2011: 53).

4.2.4. Gas plans within the Persian Gulf states, excluding Iran and Qatar

New gas developments are planned in the Persian Gulf countries over the next 5–10 years to increase their gas productions for internal use and export the surplus, as well (Oil & Energy Trends, October 2011: 7).

While the exploitation of Saudi Arabia's natural gas reserves, 40% non–associated and 60% associated (Dargin, 2008: 21), are rather expensive (US EIA 2011: 54) and more complex than other regional countries (Fredrik Palm, 2007: 52), it has some plans to raise its gas production in its non–associated Karan gas field in the Persian Gulf, out of its three off–shore gas fields, comprising sour gas fields Arabiyah and Hasbahby 2016 and developments of the Rub' al–Khali along the kingdom's southern border as well (Oil and Energy Trends, October 2011: 7–8). However, this country's gas policy in coming years is not based on natural gas exports that might reduce international demand for Saudi's oil (US EIA 2011: 54) and even turn in to the gas importer for their huge domestic use (Oil and Energy Trends, August 2011: 7–8) that is forecast to double by 2025 (M. Wietfeld, 2011: 206).

Kuwait also hopes for development of the Dorra field, which lies off–shore in the Persian Gulf, while being held up by disagreements with Saudi Arabia and Iran over the demarcation of this field's boundaries and while the United Arab Emirates decides to develop its Shah sour non–associated gas field, but both Abu Dhabi and Kuwait are net importers of gas (Oil and Energy Trends, October 2011: 7–8).

The LNG plant at Das Island, in the United Arab Emirates, has been the centre of the off–shore gas infrastructure since 1977 by ADGAS (Abu Dhabi Gas Liquefaction Co.), producing and exporting LNG primarily to Japan (M. Wietfeld, 2011: 225) and plans to develop its LNG production despite the high cost of its gas production, nearly 2.08 $/MBtu among the other regional gas holders (Lochner & Bothe, 2009: 1518–1528), but not before 2019 (M. Wietfeld, 2011: 222) though this country is predicted to face a gas deficit of 1.5 bcf/d by 2017 (Dargin, 2008: 9) and must increase imports from Qatar via the Dolphin Project, new imports from Iran, like the Salman pipeline, or produce more NG internally (Dargin, 2008:51).

According to BP (BP Statistical Review of World Energy, June 2011), Oman has expanded its gas production, a more than three–fold increase from 2000 (annex 6), to South Korea, Japan, Taiwan, Spain, France, and the US. However, its gas development depends on production of tight gas reservoirs, to some extent like Saudi Arabia, which are geologically more difficult to access than conventional gas reserves, and this led to the signing of a production sharing contract with BP in 2007 for development of the Khazzan/Makarem tight gas fields (Dargin, 2008: 11).

On the other hand, based on Oman's ambitious "Oman 2020", domestic gas demand has been enhanced (Dargin, 2008: 52), as two–thirds of total energy consumption comes from natural gas(M. Wietfeld, 2011: 222), and will rise to 16.5 bcm/a and 20 bcm/a by 2013 and 2020 respectively (EIA, 2009b), so this country has been importing gas from Qatar via the Dolphin pipeline since October 2008 (M. Wietfeld, 2011: 224) to fulfil its LNG export commitments, managed by Oman LNG and Qalhat LNG.

In Oman, like Saudi Arabia, natural gas is the main commodity for the future domestic energy consumption and that leaves more oil for export (M. Wietfeld, 2011: 222).

Unlike Qatar, in other LNG producers within the GCC, alongside some other Middle East states, the low percentage of non–associated gas reserves and growing domestic demands, have resulted in natural gas and LNG imports (US EIA, January 2011; Abi–Aad, 2009: 6) and that is unlikely to change in the future (US EIA, 2011: 62).

However, based on an interview with El–Katiri, on 9th February 2012 (annex 1), "the regional gas market within the Persian Gulf has been strongly politicised, so, these Arab Persian Gulf states are not keen to become import–dependent on another GCC country, in this case Qatar. So, currently, Kuwait and the United Arab Emirates import LNG via contracts with Shell and Vitol as well, which are at far better terms than what Qatar had originally offered".

Iraq, as the more Persian Gulf littoral state, has a number of natural gas fields, comprising Akkas, Mansuriyah and Siba with the capacity of 11 tcf (Oil & Energy Trends, 19.11. 2011: 7) and produces gas from the three large southern oilfields of Rumailah, Zubair and West Qurnah–I (Oil & Energy Trends, 18.06.2010: 7), but this country faces two main problems; widespread lack of power (Oil & Energy Trends, 19. 11.2011: 7) and considerable local opposition over the involvement of foreign companies, such as that which arose against the recent agreement over the development of the Akkas field in the troubled Al–Anbar province (Oil & Energy Trends, 19. 11.2011:8) so, it could be imagined that Baghdad would be a quite minor contributor to regional gas supplies during the forthcoming two decades (US EIA 2011: 53).

In addition, like oilfield development, there is a dispute between the Iraqi government and the Kurdistan Regional Government (KRG), whereas the KRG wants to develop various fields in Kurdistan for export, Baghdad's priority is the internal gas market (Oil & Energy Trends, 19.11.2011: 8)

4.2.5. Persian Gulf's challenges against its natural gas outlook

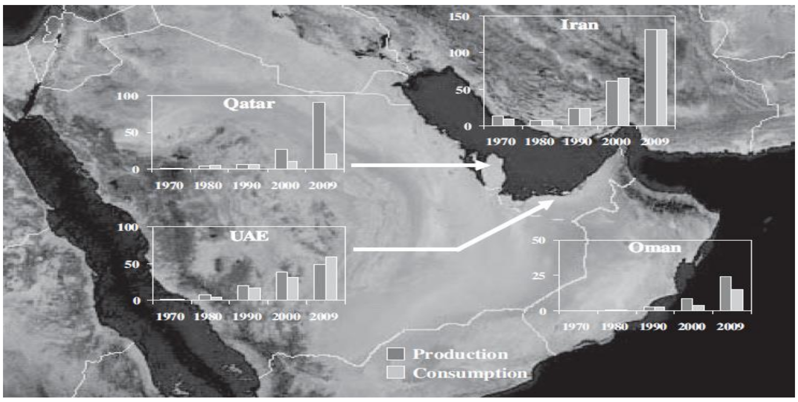
While the Persian Gulf has the highest natural gas reserves worldwide, it only accounts for roughly 12% of global production (M. Wietfeld, 2011:206) as it faces a number of internal and external challenges in order to increase its own natural gasand LNG exports in the future and also improve its ranking within the global gas market:

- ✓ Unstable political environment (Maloney, 2010: 55) and security challenges, such as the dispute over the Iranian nuclear and missile programmes, as well as political fragility and instability in some regional Arab countries, like Iraq, Bahrain, Saudi Arabia, and Yemen. These have led to intensify the balance of power system and securitise energy within the Persian Gulf (Husseinis, 2007), based on mistrust and a zero–sum game (Bauer, 2011). So, apart from some disparities within the GCC, these countries, Iran, and Iraq have been competitors rather than partners in the energy sector (Bauer et al. 2010: 7). However, the interests of all countries in the region should be to look for realistic solutions by extending political and economic bridges (Husseinis, 2007) and the GCC, particularly due to geographical proximity, should try to serve as an intermediary, along with the EU, as the Western mediator between the US and Iran over its nuclear dispute(Al–Munajjed, 2009: 6); as a result, within the framework of such this space, as during the 1990s, Tehran and the GCC could talk about confidence building, mutual defence pacts, and cooperation over the regional security matters (Ehteshami, 2003: 268);
- ✓ Subsequent to Al–Katiri's remark (interview, 2012), over "the politicisation of the Persian Gulf gas market", as the "Gulf of Politics", according to Howard Rogers (interview, 2012), any decision regarding the production, price, trade, and investment in this region has been made on the basis of political and strategic considerations, rather than "supply and demand equilibrium" (Bahgat, 2011: 82);

- ✓ Failure to attract sufficient levels of international investment, because of imposing restrictions on Western investment and presence (Young, 2009: 57), unstable regional situations and some governmental rules, preventing a suitable partnership by the Oil International Companies (OIC) or other overseas energy companies (G.Victor et al. 2006), despite the economic venture in the Persian Gulf region, for instance Saudi Arabia rejects any foreign investment in upstream projects (exploration and development), while Iran and Kuwait impose strict conditions on foreign participation, so most capital goes to other areas (Bahgat, 2011). Notwithstanding some Middle Eastern gas producers suppose that foreign direct investment (FDI) would be unpopular with their people (Young, 2009: 54), but Qatar and the United Arab Emirates with exceedingly authoritarian regimes have been open to overseas ventures in their oil and gas sectors (Young, 2009: 57).

- ✓ High indigenous gas demand (M. Wietfeld, 2011: 203–228), however domestic gas consumption differs from one country to another one, for instance the most internal demand belongs to Iran, but other littoral states have already faced growing demands as well and these will rise in the future. Qatar, contrary to other ones, and Oman, to some extent, have LNG productions which are higher than consumption, while its demands have been steadily rising and will continue to do so in future, so the latter has to import gas from the former;

Map 7: Production and domestic consumption in Persian Gulf countries (bcm)



Source: M. Wietfeld, 2011: 207 (based on BP, 2010: 24 & 27; CEDIGAZ, 2009: 10 & 34)

- ✓ Energy inefficiency and dependence on hydrocarbon consumption, although there is a fast growing awareness of the potential of renewable energy sources in the Persian Gulf, especially solar and wind energies, particularly by the establishment of the EU–GCC Clean Energy Network Project launched at the end of 2009 (Bauer et al. 2010: 7). Accordingly, Saudi Arabia plans to be a main centre for solar energy research and also Masdar City in Abu Dhabi, as the headquarters of the United Nations International Renewable Energy Agency (IRENA) and the world's first city that will fully depend on renewable energy sources are two more examples in this respect. Iran has invested in renewable energy sources, especially solar plants, and inaugurated a huge solar power plant in Shiraz in 1391/2012, as the first solar plant in the Middle East, and was joined to this club after the US, Spain and Germany (IRINN.ir, 16.01.1391/ 04.04.2012). Hence, energy efficiency and development of renewable energy sources in the Persian Gulf states could save their natural resources for export and guarantee hydrocarbon supplies for the region (Al–Munajjed, 2009: 10 & 11).
- ✓ The emergence or expansion of other LNG developers, such as the US, with unconventional gas, and Australia (Abi–Aad, 2009: 6).

It is obvious that the Persian Gulf states should remove these obstacles locally with collaboration with each other and also internationally with the partnership of influential players. This trend could accelerate the emergence or expansion of regional natural gas plans and help security of supply.

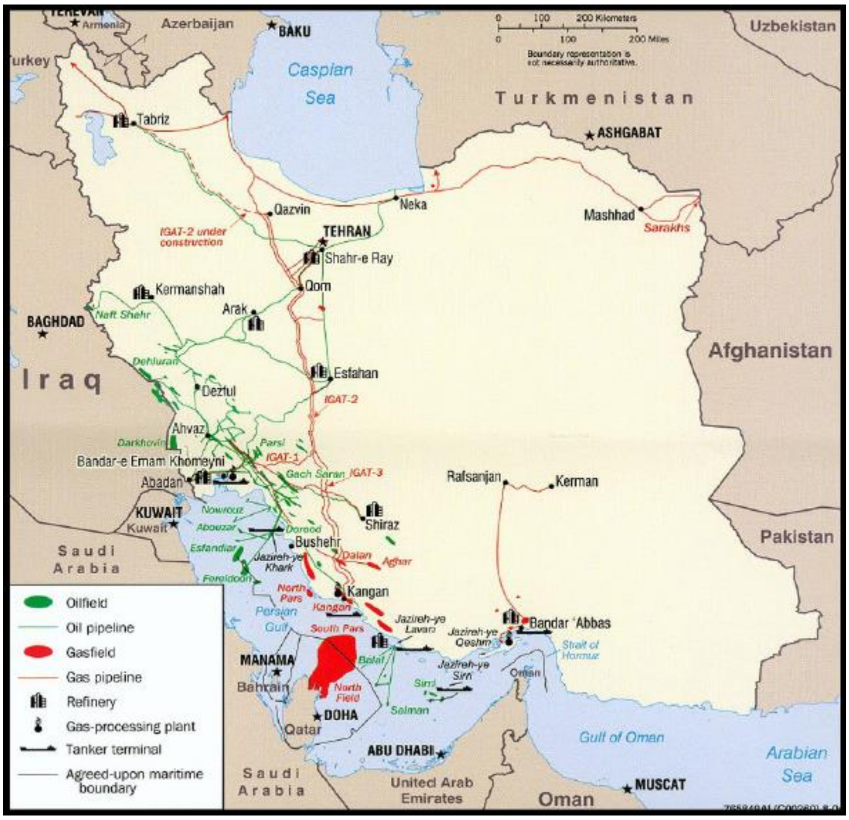
4.3 Geo–politics of natural gas in Islamic Republic of Iran

In an increasing energy–hungry world with the new emerging economies, energy development and the best transport routes have been important (Akhlaghi, 2009). So, Iran has some prominent features with its global geo–political position and geo–strategic importance based on its hydrocarbon reserves (Rogers, 2012: 168–174).It is the only bridge between the Middle East/Persian Gulfin the south and Central Asia/the Caspian Sea in the north, with over half of the world's known hydrocarbon reserves (K. Kashgari, 2011) and the short and cheap energy corridor for Caspian, and to some extent, Persian Gulf basins. It, moreover, aims to transfer hydrocarbons to India subcontinent, Far East, Europe and Africa with the current broad pipelines, potential LNG and facilities alongside the skilled workers (Mojtahed Zadeh, 1389/2010: 268). Therefore, while the northern parts of this country are parts of the heartland, Iran's position has played the role of the Rimland of this heartland with the 1,259 km coastline along the Persian Gulf, according to Spykman (Taghavi–Asl, 2008: 49–52) and situated at the centre of the "Energy Ellipse", according to Geoffrey Kemp (Kemp & Harkavy, 1997: 111). These figures were highlighted in John Woolf's remarks (Woolf, 2000), as the US' representative in the Caspian Sea seminar in London over the role of Iran between the two most important huge energy basins in the 21st century.

According to the US Department of Energy's report (US.EIA, 2007), EIA (EIA International Energy Outlook 2011: 64) and Oil and Gas Journal (Oil and Gas Journal, as of January 2012 in table 21), Iran owns the world's second biggest natural gas reserves, with 17.3% of the global known reserves (annex 20).

The majority of Iranian natural gas reserves are situated in South and North Pars, Kish, Kangan–Nar, Golshan, Ferdowsi, Aghar, Dalan, and in the lesser fields, such as Homa, Khouzestan, Kish, Mozdouran, Nar and Kangan, Sarajeh, Sarkhoun, Shanol, Shourijeh, Tabnak and Varavi (Oil and Gas Journal, as of January 2010). However, the bulk of 62% of these deposits remains unexploited (US EIA, 2007; BP, Statistical Review of World Energy, 2009), for example Kish, with estimated reserves of 50 tcf, is expected to produce 3 Bcf/d of gas with two phases in 2016 while other of Iran's gas projects, such as Golshan, Ferdowsi, and North Pars gas fields are unlikely to come in to operation until the next decade (http://www.eia.gov/countries/IRI).

Map 8: Iran's proven hydrocarbon reserves and existing infrastructure



Source: Policy Brief (2008), Issue No. 6, Centre for Iranian Studies, School of Government and International Affairs, Durham University: 4

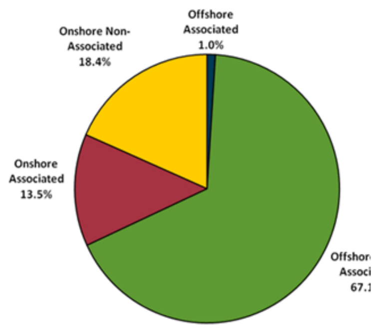
Moreover, regarding the field size and the amount of non–associate gas Iran is a world leader (Chapter 5).

According to figure 47, Iran's natural gas reserves are predominantly located off–shore, more than 68%, although more than 85% of these reserves are non–associated gas (figure 42). The South Pars, as the largest non–associated gas field in the world, is the name of the Northern portion of the joint field with the Qatari North Dome in the Iranian territory, discovered in 1990 and located 62 miles off–shore in the Persian Gulf (Mashal,08.04.2011: 2). It needs a $50 bn spending programme to complete the development of this giant field (Oil & Energy Trends, 16.04.2010: 8) so, according to Mousa Souri, General Manager of the Pars Oil and Gas Company, the South Pars would be worth roughly $8,800 bn and it would be more than Iran's oil revenue since the exploration of crude oil in this country at the beginning of the 1900s and also cost nearly 100 years of oil exports based on $100 for each barrel (“Gas hidden war” (1390/2012), Iran Economics, No. 156, Bahman/ February).

4.3.1. Islamic Republic of Iran’s regional pipeline projects

Under Article 229 of the “Fifth Development Programme 2010–2015”, 10% of Iran’s annual oil income has been devoted to the development of the South Pars, which started production in early 2002 and the 24 phases should be in operation by the end of the programme (Mashal,08.04.2011: 2) .

Figure 47: Composition of Iranian natural gas reserves



Source: The US EIA at: http://www.eia.gov/countries=IR

According to table 17, five of the first eight blocks in the South Pars are designated for domestic markets and three of which for oil field reinjection. Any more exports primarily depend on blocks 9 and 10. A number of LNG projects have been proposed as well, however, only one LNG project still remains in place, Iran LNG in phase 12, and sanctions continue to delay the development of these projects. The other LNG projects in the South Pars, including Pars LNG (the South Pars’ phase 11) and Persian LNG (the South Pars’ phases 13 &14) have been on hold as a result of financing difficulties and political disputes (www.eia.gov/countries/ IRI).

So, the first 10 phases of theSouth Pars have been inaugurated from 2001 until 2007 and also the phases of this huge complex will probably increase to 28 (Usefi & Naderian, 2011: 98) in order to increase production capacity from 260 bcm/y to 1410 bcm/y during the future decade (Usefi & Naderian, 2011: 103).

Ayatollah Khamenei, in the first week of the 1390, Iran’s solar calendar, (March 2011) visited different natural gasand LNG projects and stages in the South Pars region personally showing the significance of the progress of these plans in line with Iran’s Energy Outlook.

Table 17: The South Pars' project phases

Completed Phases			
Phase	Capacity (NG; condensate)	Participating companies	Start- up
1	1 bcf/d; 40,000 bbl/d	Petronas; Petropars Ltd	2003
2 & 3	2 bcf/d;80,000 bbl/d	Total; Gazprom	2002
4 & 5	2 bcf/d;80,000 bbl/d	Eni; Petronas; NIOC	2004
6 & 7 & 8	3.9 bcf/d; 156,ooo bbl/d	Statoil; Petropars Ltd.	2008/2009
Future, Ongoing Phases			
9 & 10	2 bcf/d; 80,000 bbl/d	LG International; OIEC, IOEC	2011/2012
11	2.0 bcf/ d; 80,000 bbl/ d	NIOC; CNPC	2015/2016
12	3 bcf/d; 110, 000 bbl/d	SonAngol; PdVSA; Petropars, Ltd	2013/2014
13	2 bcf/d; 77, 000 bbl/d	Mapna; SADRA; Pedro Paydar	2016/2017
14	2 bcf/d; 77, 000 bbl/d	IDRO; NIDC; IOEC	2016/2017
15 &16	2 bcf/ d; 80,000 bbl/ d	KACH; IOEC; saaf; ISOICO	2014/2015
17&18	2 bcf/ d; 80,000 bbl/ d	IDRO; OIEC; IOEC	2015/2016
19	1.8 bcf/d; 77,000 bbl/d	Petropars Ltd.; IOEC	2017/2018
20 & 21	2 bcf/d; 75,000 bbl/d	OIEC	2016/2017
22 & 23 & 24	2 bcf/d; 77,000 bbl/d	Petro Sina Arian; SADRA	2015/2016
25-28	Recent Discovered		

Source: By Author, based on the US, EIA at: http://www.eia.gov/countries/cab.cfm?fips=IR& www.nigec.ir/

Howard Rogers (interview, 2012) explains that "Many International Oil Companies' have long hoped to be able to access to the on–shore and off–shore oil and gas development opportunities in Iran, particularly LNG development on the South Pars field, as an attractive opportunity".

Iran's history of utilising natural gas dates back to 1873 where it was used for fuelling street lamps (Hariri et al. 2011: 1), while Iran's gas exports started around 1344/1965 from Khouzestan province to USSR via the 1106 km–long pipeline, but until 1983, most of the gas produced in Iran was associated from the major common oil and gas fields, generally used for gas injection to oilfields, and this production increased slowly but steadily through the 1980s thanks to the development of a number of on–shore and non–associated gas fields. This trend continued to grow through the remainder of the 1990s (BP 2010: 24).

Iran's gas production has risen strongly since 2002 and there are a number of regional and ultra–regional plans under consideration and under construction, including pipelines and LNG that are set to be online for a further sharp rise in gas production, and the start of exporting gas on a large scale, while, given these giant hydrocarbon deposits and geo–political location, this country is now considered an energy superpower (M.P. Amineh & O.H. Holman, 2010: 63; Luft, 2011).

Development of the South Pars has shifted the focus of Iran's energy policy from oil to a balance between oil and gas exports (Crane et al. 2008: 71), but some of these plans are already behind schedule or held up because of political and technological concerns (Oil & Energy Trends, 18.02.2011: 5).

Iran has currently an extensive gas domestic pipeline system, more than 33,000 km, connecting most of the urban and rural areas (Shana News, 1390.01.14/ 01.04.2011) and should increase up to 70,000 km by 1404 (2023) (Imam, 1390/2011: 10).

Moreover, these domestic pipelines have partially extended to the neighbours. The 745 mile long Iran–Turkey pipeline, completed in 2001, and the 87 mile long Iran–Armenia pipeline can transport up to 1.4 bcf/d and 86 mcf/d of natural gas, respectively, to be added to by another gas pipeline currently under construction from Khoi in north–west Iran to Republic of Azerbaijan (http://www.nigec.ir/).

Iran's gas authority decided to develop IGAT (Iranian Gas Trunkline) pipeline series from South Pars (map 8). Accordingly, IGAT–7 (2011) transports up to 3 Bcf/d of gas along southern Iran, between Assaluyeh (the South Pars' gas fields) and Iranshahr. IGAT–8 (2012/2013) will run nearly 650 miles to Iran's northern consumption centres, including Tehran. IGAT–9 or Persian pipeline, which is 1863 km long, is set to primarily send $8 bn worth of gas from Assaluyeh to the north–western city of Bazargan, near the Turkey border by around 2013 and this volume could increase up to 30–35 bcm/y under plans to export to Europe (www.nigec.ir/projects), more than the potential Nabucco and Gazprom South Stream's capacities (Molavi & Shareef, 2008: 6) aided collaboration of foreign investors and local contractors (www.nigec.ir/projects). So, negotiations started in the middle of the 2000s, with Greece, Austria, Italy, Germany, and Switzerland, while France and Spain will be added to these countries (http://www.nigec.ir/projects & www.eia.gov). Gas export to Switzerland (EGL) from IGAT–9 is set to export 5.5 bcm/yr natural gas to Switzerland and elsewhere in Europe for a 25–year period. In addition, Gas export to Austria (Econgas Pipeline), originating from IGAT–9, is expected to contribute in the Nabucco consortium from the Caspian Sea's gas basin to Europe (http://www.nigec.ir/projects) whereas, the potential 3,900km Turkmenistan–Iran–Turkey–Europe gas pipeline with the help of Shell, could also supply up to 30 bcm, as an alternative for Nabucco (Molavi & Shareef, 2008: 6). The IGAT–10, however, is still in the planning phase and is unlikely to become operational before 2017 (www.eia.gov).

Iran, moreover, predicts that by 2014 it will be exporting natural gas to some Persian Gulf states, such as Kuwait, Bahrain, the United Arab Emirates and Oman (Tehran Times, 03.09.2010). On this basis, Iran and Kuwait have been holding talks on the construction of a 570 km–long pipeline, but the two sides have yet to agree on the gas price and governing rules. There have been negotiations between Bahrain and Iran to transport up to 10 bcm/y of natural gas over a 25–year period, but there have been inconsistencies after bilateral political tensions in February 2009 and domestic instability in Bahrain since February 2011.

A negative example of the relationship between Iran and the United Arab Emirates is the contract, signed between The National Iranian Oil Company (NIOC) and the United Arab Emirates–based Crescent Petroleum Company, which resulted in arbitration proceedings in 2009 over unresolved disagreements about the gas price, but the positive aspect, is an memorandum of understanding (MoU) in September 2009 between the National Iranian Gas Exports Company (NIGEC) and a foreign company aimed at exporting gas to the United Arab Emirates over a 25–year period.

Given Oman's LNG units and industries, it would be Iran's potential gas client in the Persian Gulf region. However, the dispute over the gas price has yet to finalise an agreement between these two countries.

In an electronic interview on 7th March 2012, Prof. Giamoco Luciani (annex1) argued that "the probable lack of serious determination to export on the Iranian part by squeezing of the customers, while natural gas is a competitive business, is a barrier against Tehran's gas export prospects", while Ledesma (annex1) in an email communication on 16th February 2012 insists on this point and believes that "following Iran's ability to secure LNG technical skills, it would be a secure market for LNG on a long–term basis".

Iran, moreover, plans to start exporting 8.7 bcm/y piped gas to Pakistan in a 25–year deal (Shana Petroleum New Agency, 29/02/2012) by the middle of 2012, while the bilateral disagreements have been resolved, according to Hamid Ahmadi Sharaf, the project manager of Iran's gas export to Pakistan, (Mashal, 08.03.1390/ May, 2011: 5) by extension of Iran's domestic IGAT–7 pipeline into Pakistan (http://www.eia.gov/countries/IRI). However, this could be extended further to India through a 1,724–mile IPI or Peace Pipeline from the South Pars by 2014, while Delhi has some dispute with Tehran over the gas prices and transit fees through Pakistan's soil, apart from Washington's pressure on Indian officials to cancel this project. Consequently, Iran and India started discussions on an off–shore route through the Sea of Oman (bypassing Pakistan). So, if Iran could succeed in transferring its gas to Pakistan and India, it could promote peace within South Asia, leading to an increase in Iran's international position (Kandiyoti, 2008: 111).

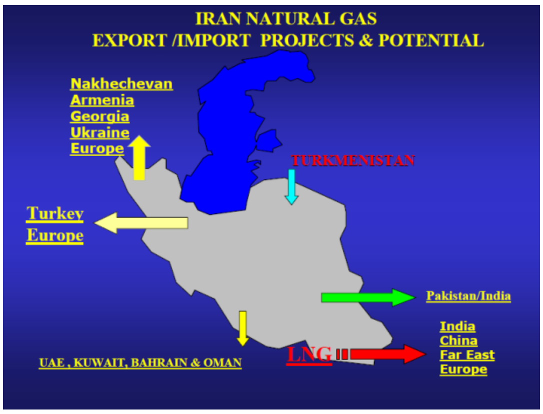
Iran's swap contract with Turkmenistan followed by inauguration of the Dauletabad–Sarakhs–Khangiran pipeline in early January 2010, produced a more regional gas program, connecting Iran's northern Caspian region to Turkmenistan's gas field. Iran, moreover, signed another contract with Republic of Azerbaijan in December 2009 over the 1,400km Kazi–Magomed–Astara pipeline after another swap contract with Baku in 2002 (nigec.ir/default)

Nevertheless, National Iranian Gas Exports Company proposed that Iran and Russia could reach a durable bilateral swap agreement, based on mutual national, as well as European interests. Accordingly, Iran's northern countries receive roughly 10 bcm/y natural gas from Russian Gasprom and Tehran exports a similar amount of natural gas to Europe (nigec.ir/default).

Additionally, the governments of Iran, Iraq and Syria on 03.05.1390/ 25 July 2011 have signed a draft to build the 1500 km–long Islamic pipeline aimed to transport 110 mcm/d natural gas from the South Pars to Iraq, Syria, Lebanon and then extending to Europe via the Mediterranean Sea, bypassing Turkey, by sending roughly 68–80 mcm/d out of 110 mcm/d to this continent (Oji, 25.02.1390/15.05. 2011: 5). However, this project has been suspended a result of the turmoil in Syria since March 2011 (http://www.eia.gov/countries/IRI). Although, Javad Oji, the General Mamager of National Iranian Gas Company (NIGC) argued in Iranian senior energy managers' summit that "Iran must export gas to the EU via Iraq, Syria and Turkey by two independent ways" (Shana Energy News Agency, 27.10.1390).

Map 9 illustrates the whole of Iran's current and coming pipelines and LNG projects to be added to by LNG exports to the EU in the future, and in order to realize these projects, Tehran's top officials approved a grand energy outlook up to the middle of the next decade.

Map 9: Iran's natural gas and LNG projects



Source: Ghasemzadeh, Davood (2005), "Natural Gas Industry in Iran", Baker Institute for Public Policy, Houston, Texas, the US, 5th May: 22

4.3.2. Islamic Republic of Iran's Grand Energy Outlook Document by 1404/2023

The government has recognised the economic and political benefits of utilising natural gas for Iran's domestic consumption, as well as export purposes, a fact clearly illustrated in the 20–Year Outlook Plan (2005–2025). On the basis of "Iran's 20–Year Outlook Document" issued by Iran's Supreme Leader in 2003 (1382.09.11), the Article 44 of the Iranian Constitution, moreover, was amended in 2004 to allow the privatisation of the state–run companies as an important step toward the realisation of the aims of this document, including energy firms. So, this modification was followed by Ayatollah Seyed Ali Khamenei's recommendation to the government in 2007; as a result, the officials have announced a reduction in state–ownership in the economy by 20% in 2015.

The four main targets in this document are related to the energy policy that Tehran should achieve by until 2025, so Iran must be:

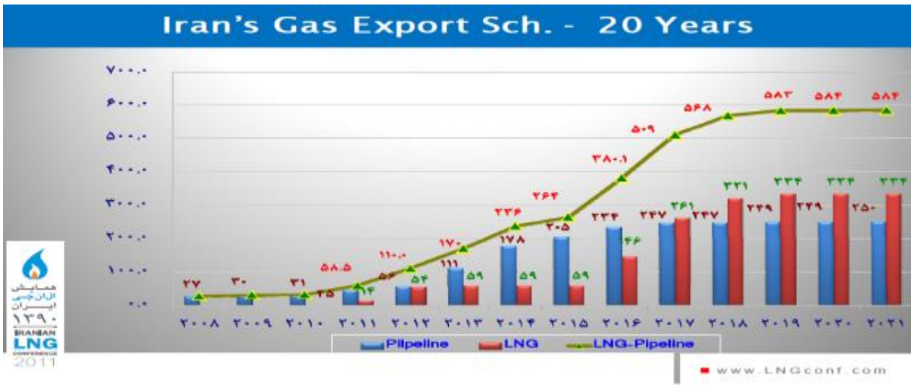
- The first producer of petrochemical products in the region;
- The second largest oil producer within the Organization of Petroleum Exporting Countries (OPEC) with a capacity of 7% of global market demand (of course before the recent oil sanction having started in July 2012);
- Third largest gas producer in the world with 8% to 10% of global market, putting Iran in the second position of gas exporters worldwide;
- First place in the area of oil and gas technology in the region (www.mop.ir).

Iran's Majlis or Parliament Energy Commission in 1387/2008 called for the Ministry of Petroleum, the Ministry of Power and some other organizations to study a medium/long– term energy plan, based on the 20–Year Outlook Plan, leading to publication of "Iran's 20–year Energy Grand Strategy Document", as the Iran's energy roadmap for the use of all available capacities in the energy sector (www.vision1404.ir).

Iran's "Fifth Five–Year Development Plan (2010–2015)" is part of the "20–Year Outlook Plan (2005–2025)", which is the country's main blueprint for long–term sustainable growth.

Based on Iran's gas export outlook, published by Ministry of Petroleum during the LNG conference in Tehran, October 2011 (figure 48), until the beginning of the 7th development plan, starting in 1400/2021, this country should increase natural gas and LNG exports to other importers in order to achieve the third energy target of "Iran's 20–Year Outlook Document" and strengthen its market position (Soligo in G.Victor et al. 2006). That requires, according to Mostafa Kashkooli, deputy of National Iranian Gas Company, the need to reinforce infrastructures, including refineries, transmission networks, etc. (Kashkooli, 04.03.2012: 5).

Figure 48: Iran's natural gas and LNG export schedule, 2008–2021



Source: Iran's LNG conference, Tehran, October 2011

Evidence given by Javad Oji (annex 1) in an interview on 15th April 2011 and also a personal conversation on the fringe of the "the role of Iran's natural gas in global energy security" Conference, which took place in Tehran, he argued that, while global gas demand will dramatically rise by 2020 and 2030, based on Iran's 1404/ 2023 Energy Outlook, upstream and downstream gas industries should attract the necessary investment from existing $37 bn to $101 bn. On this basis, if the phasing out subsidy process is implemented properly, then it could lead to more fuel efficiency and energy saving with more orientation towards exports through pipelines, as well as LNG shipments (Oji, 10th July 2011: 5).

4.3.3. LNG projects in Islamic Republic of Iran

Iran has a number of plans to construct and develop its LNG projects and make use of them in addition to the mentioned pipeline projects.

In a conversation on 13th January 2012, Dr. Mohsen Ghamsari (annex 1) argued that "an inevitable way for Iran to hold 8%–10% of global gas trade in the future is access to and rapid development of LNG industry, because of its flexibility, trading with wider range of gas consumers, achievement of high–tech LNG industry, more bargaining power against the ultra–regional buyers (C. Jansen & Seebregts, 2010: 1656), earning of higher export revenues, as well as better political relationship with other countries due to sign longer term contracts".

Luft and Korine also believed (2009: 13) that "without LNG there would be no way for Iran to sell its gas to some far–distance importers in the east like China, and to the west, like EU countries in order to increase its share in global gas market in the future".

Clément Therme (annex 1) in an interview on 25th May, 2012, confirmed this point and argued that Iran should try and ensure that the imposed sanctions be lifted in order to develop its LNG industry, coincidental with containing progressive domestic gas demand. So, in this case, Tehran could increase its share in global gas markets and participate in the GECF more actively.

That is because, Iranian Oil Minister, Rostam Qassemi, in Iran's LNG Conference which took place in October 2011, in Tehran, called LNG a "strategically important issue", leading to improve Iran's position within the international gas market. He added that "pipelines meets domestic needs and transfer natural gas to the neighboring countries, even though LNG helps to diversify of the country's energy basket and helps access to remote areas" (Shana Energy News Agency, 24th and 25th October 2011).

Ghamsari (interview, 2012) also believed these remote areas should be Asian and European LNG markets, while the global markets face a shortage of LNG supply after 2013, due to the late arrival of new capacities, fuel switching in Japan, the

EU's tendency to reduce its dependence on Russian piped gas, etc., so "without LNG industry, Iran is not powerful enough".

The National Iranian Gas Company, a subsidiary of the National Iranian Oil Company and as the body responsible for Iran's gas infrastructures, was created in 2003 and manages and supervises all Iran's gas pipeline and LNG projects, while since May 2010, the Ministry of Petroleum transferred the National Iranian Gas Export Company (NIGEC) under the National Iranian Gas Company's supervision in an attempt to carry out LNG investments and projects on behalf of the National Iranian Oil Company, as well as taking responsibility for Iranian gas marketing and sales all over the world (US EIA 2011: 52). Furthermore, the National Iranian South Oil Company (NISOC), as the subsidiary of the National Iranian Oil Company, is responsible for much of the southern gas production, but the entire South Pars project is managed by the Pars Oil and Gas Company (POGC), a subsidiary of the National Iranian Oil Company, and the Pars Oil and Gas Company is responsible for dividing of upstream and downstream LNG developments in the South Pars amongst the various companies. Iran's LNG production will come from different projects, each associated with a phase of the South Pars development: Pars LNG (phase 11), Iran LNG (phase 12), and Persian LNG (phases 13 and 14).

Table 18: Iran's LNG projects

Project	Volume	Gas Feed From	Shareholders	Status	markets
Iran LNG	10.6 mtpa (2 trains)	SP, Phase 12	NIOC (49%) Persian Funds(51%)	Under development, (start 2015)	Asia (China & India) Europe
Persian LNG	16.2 mtpa (2 trains)	SP, Phase 13 & 14	NIOC (50%) Shell (25%) Sinopec (25%)	Proposed, (start 2017)	Asia (specially China, Thailand & India)
Pars LNG	10 mtpa (2 trains)	SP, Phase 11	NIOC (50%) Total (40%) Petronas (10%)	Proposed, (start 2017)	Europe Asia (China, Thailand & India)
Golshan & Ferdowsi	10 mtpa (2 trains)	Golshan & Ferdowsi fields	Malaysian Petrofield (100%)	speculative	Malaysia Europe
North Pars	20 mtpa	North Pars field	Chinese CNOOC & SITOK	speculative	China
Qeshm LNG	3.5 mtpa	Kish field	Australian LNG Ltd.	speculative	Indian, East Africa
Lavan LNG	4 mtpa		European Company	speculative	Europe

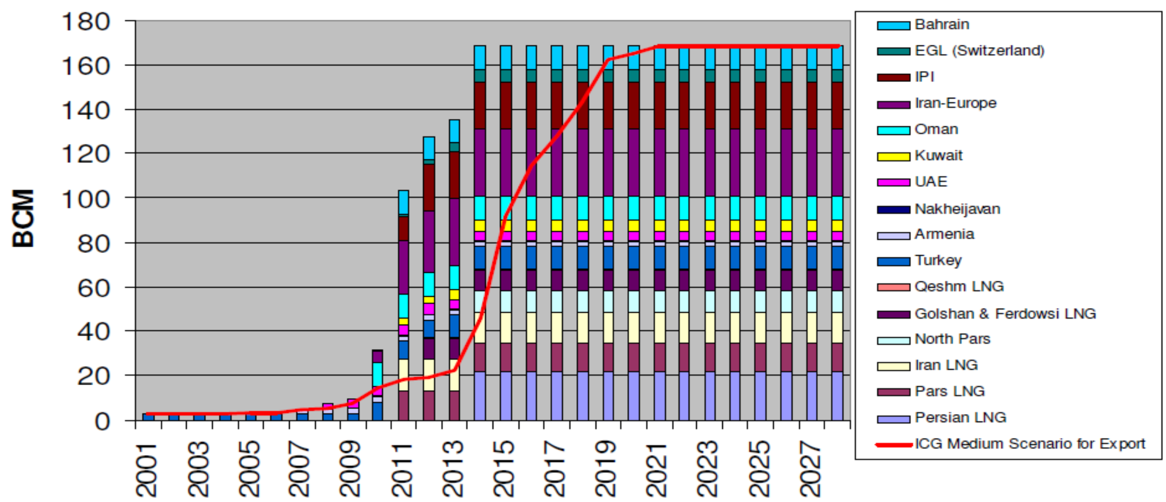
- SP: The South Pars

Source: by Author, based on MoP, NIOC, NIGC data; Platts, 2010: 10

If Iran's currently planned LNG projects together with those under construction come in operation, it would be among the top five exporters worldwide by 2020, providing that Tehran is able to attract the required investment, finance, and technology from international institutions and companies and achieves its aims to participate in the international LNG chain with the appropriate time scale. This is according to the personal comments, in an interview by the author with Dr. Hossein Iranmanesh (annex 1), the Head of the Institute for International Energy Studies, in Tehran, in the sideline of the 8th International Energy Conference in Tehran, Iran, on 24–26 May 2011.

Hence, if Iran follows a moderate approach and takes steps in order to attract the required investment and reduce the political tensions, the whole of the National Iranian Gas Export Company's plans for LNG and piped gas exports could be realised by 2021. In that case "Iran's Energy Outlook on the Horizon of 1404/2023" regarding gas export could fully materialised. However, some of these plans, based on the mentioned approach and scenario, like Pars LNG and to some extent, Iran LNG, have not yet commenced in 2012 and some have even been suspended. Nevertheless, Tehran has the potential to accelerate its progress, particularly after 2013, based on the red line (figure 49).

Figure 49: Natural gas and LNG exports projects by NIGEC, 2001–2027



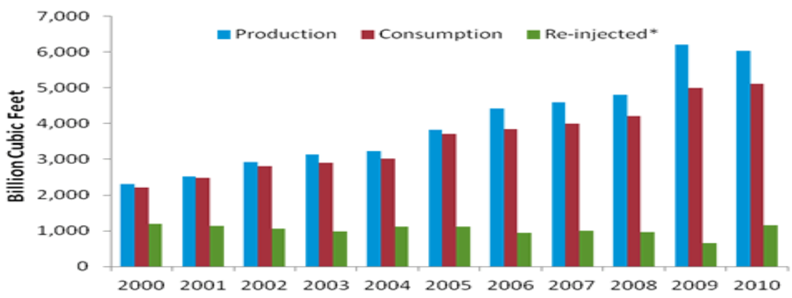
Source: Hariri et al. 2011, Idam Consulting Group: 16

4.3.4. Islamic Republic of Iran's main obstacles against its piped gas and LNG targets by 2023

As Bahgat (2010: 333–347) and a lot of experts and even policy–makers argue that Iran's goal to become a major global natural gasand LNG exporter has been restricted and hindered by two main impediments, including high domestic consumption and foreign sanctions, so, Iran cannot fully utilise its massive gas resources without the necessary foreign investment and technology.

Iran is also the Middle East/Persian Gulf's largest user of re–injected natural gas for enhanced oil recovery operations and this will continue to rise until 2020 (US EIA, 2011: 54).

Figure 50: Iranian marketed natural gas production and consumption, 2000–2010



Source: The US EIA at: http://www.eia.gov/countries/cab.cfm?fips=IR

For the time being, around 65 million people, out of nearly 77 million total population, in Iran use natural gas as the main fuel (Shana Energy News Agency, 19.10.1390) but as a result of the heavy public subsidies and low gas price (Bahgat, 2010: 333–347) this resulted in energy inefficiency (M. Wietfeld, 2011: 210). Iran's Majlis on 5th January 2010 ratified the subsidy reform plan which aimed to bring prices to the real market level by the end of the fifth development plan, 2010–2015, (Tehran Times, 25.01.2010). As a result, high domestic gas consumption in Iran, has started to ease since 2010 (BP Statistical Review of World Energy, June 2011), for instance, gas consumption in winter 1389/2011 fell around 1.5% to 5% in comparison with the same time in 1388/2010 (Mashal, 01.05. 2011: 5).

The Institute for International Energy Studies, in Iran, in its unpublished recent report in 2011 (Usefi & Naderian, 2011: 209) argued that while this country has been an importer of natural gas, but with respect to the huge reserves, its outlook and plans, as well as the fall in domestic consumption by the reduction or stopping of the gas subsidy, the country is seeking to actively participate in export markets in the future.

Lovatt (2010: 4), moreover pointed to gas flaring, as another evidence of inefficiency, while roughly 150 bcm/y of gas is flared globally, Iran was foremost at 10.3 bcm/y in 2008.

The Iranian gas sector is in need of modernisation, alternative sources of energy, more energy efficiency in order to fulfil domestic energy demand without endangering export capacity (P. Amineh & H. Holman, 2010: 60), as well as requiring widespread foreign investments for gas reserves to be developed (Bahgat, 2011: 65), as National Iranian oil Company lacks the necessary capital and technologies to develop new gas fields (Crane et al. 2008: 68).

Moreover, Iran has paid more attention to renewable energy sources, like solar, according to Javad Oji (Shana Energy News Agency, 19.10.1390) and this has considerable potential for using non–hydrocarbon, as well as impacting on energy conservation (Rogers, 2012: 168–174)

Iran's gas production, on the other hand, has increased by over 550% since 1990 (http://www.eia.gov/countries/IRI) and even increased strongly in 2009 and 2010 (BP Statistical Review of World Energy, June 2011), ranking Iran as the fourth global gas producer. This country's gas production during the 41 years up to 1389 (2010) was around 1,860 bcm, while Iran's production in 1389 (2010) was 9% of this total number, equivalent to the first 20 years of production, because of the increase of production from the 6th, 7th, and 8th and also inauguration of the 9th and 10 phases of the South Pars (Mashal 22.03.1390/12.06.2011: 5). Iranian production of gas is expected to increase over the next few years due to continuing discoveries in Persian Gulf reserves, particularly the South Pars (Oil & Gas Directory Middle East, 2011: 1075) so, the Ministry of Petroleum announced that Iran could reach its planned gas production from around 219 bcm/y in 2011 to between 400 bcm/y and 440 bcm/y until the end of the 20–Year Energy Outlook (www.nigec.ir/default) and export even more than 200 bcm/y (Oji, 29th July 2011: 5), while the capacity of gas production in 1385/2004 was 350 mcm/d (Oji, 10th July 2011: 5).

However, so any rise in Iran's gas production is related to the structural industrial and technological changes and more attractive rules (Aarts & Van Duijne, 2009: 74) the aim is to absorb $200 bn of investment by the end of the Five–Year Development Plan in 2015 for the whole energy industry (Oil & Gas Directory Middle East, 2011: 1075). Iran's Oil Minister, Rostam Qasemi, stated that $40 bn was needed for the development of the new Iran's oil and gas fields.

Given that Iran's constitution bans foreign companies from holding shares in Iran's reserves or participating in the form of Production–Sharing Agreements (PSAs), some believe that this law is a barrier against the flow of foreign capital (M. Wietfeld, 2011: 214). Nevertheless, Tehran has developed the third generation of buy–back contracts and "sweetened" them with more incentives, such as raising the rate of return (Bahgat, 2010), as well as lengthening the number of years of buyback (Fesharaki, 2007: 31–33).

Howard Rogers (interview, 2012) describes the buy–back scheme as an unattractive and inappropriate method of attracting foreign capitals, while "a more progressive and risk–sharing framework allows the International Oil Companies' to operate production projects on a long–term basis, being a necessary component of successful Iranian LNG development".

Clément Therme (interview, 2012) counted the buy–back contract, in addition the imposed sanctions against Iran, as an impediment against venture flow, while "it only allows the investor to pay off its investment and generate profits based on the performance of the field it puts in production".

Iran has been under various US sanctions since 1979, like The Iran and Libya Sanctions Act of 1996 (ILSA), prohibiting US and other energy companies from participating in oil and gas projects, denying Iran access to some of the technology it needs to develop its gas fields, even though over 50 countries have invested in Iran's gas industry during the period 1992 to 2008 (Groot, 2010: 64–65). This has led to Tehran's approach changing toward cooperation with Brazilian, Russian, Chinese, and Malaysian corporations which do not possess the more advanced Western technology (Bahgat, 2010; Amineh, 2010: 61).

The United Nations Security Council, moreover, imposed some more sanctions against Tehran owing to its nuclear programme, including 1737 (23rd December 2006), 1747 (24th March 2007), 1803 (3rd March 2008), 1835 (27th September 2008),and 1929 (09th June 2010) so, in nearly all the primary and secondary sources, including interviewees, journal and book writers, analysts, etc, that have been studied by the author, it has been insisted that Iran must attempt to be removed from these imposed sanctions against itself in order to achieve more progress in its energy industry and increase gas production, to counter consumption.

The US pressure on foreign energy companies to withdraw from Iran's project has been obvious during the recent years, such as in the Nabucco project, while Tehran was not invited to the international summit in Turkey in June 2009, despite Ankara's and some European's desire for the presence of Iranian officials (Houshialsadat, 1388/2009).

Hassantash (annex 1) in a communication and interview on 14th February 2012 explained that Tehran should solve these political disputes first, while he insisted on an integrated gas policy in Iran.

Peimani (interview, 2012) and Bahgat, in an interview on 16th February 2012 also insisted that Tehran must solve the current political disputes with the US firstly, primarily regarding nuclear issues and then most of the Iranian and the EU's problems could be resolved more easily. So, Iran's energy plans face difficulties until tensions ease over Tehran's nuclear programme (Oil & Energy Trends, 17.09.2010: 6).

Moreover, Korine, (interview, 2012) added "the potential disputes and rivalries among the Persian Gulf states and differences with Iran", mostly because of its nuclear programme are other barriers to the expansion of Iranian LNG exports, in parallel with sanctions, that should be dealt with, while El–Katiri (interview, 2012) insists that this harsh political situation in Iran–GCC relations is not helpful for Iranian LNG shipments.

In summary, if Iran wishes to increase strongly its gas production and develop LNG facilities, it needs to decrease its domestic consumption, as well as attempt to solve political disputes, leading to a normal international situation, but, of course, without imposed sanctions.

4.3.5. Islamic Republic of Iran's three major scenarios regarding the two impediments

There are three main scenarios regarding the two principal impediments against Iran's natural gas export in the future that impact on gas and LNG production during the 20–Year Outlook Document and beyond.

Clément Therme (interview, 2012) defined three "pessimistic, progressive and optimistic scenarios" regarding Tehran's future gas production, as follows:

- Low Production Scenario (pessimistic): Both foreign and domestic investment in the gas sector remains low due to the continuation of economic sanctions against Iran, while its domestic energy companies try to develop gas fields, like some phases in the South Pars, but some of the plans, such as LNG projects should be operationalised by foreign companies. So, based on this black scenario, the nuclear dispute escalates, strong sanctions are taken by the mostly Western powers, leading to more instability in the Middle East/Persian Gulf, such as what has happened in the region, notably since January 2012. The result is not only lower investment, but combines all catastrophic forecasts and consequences.
- Medium Production Scenario (progressive): Foreign and domestic investment will remain low by 2014, but will increase thereafter due to the economic climate improvement and easing of sanctions against Iran.

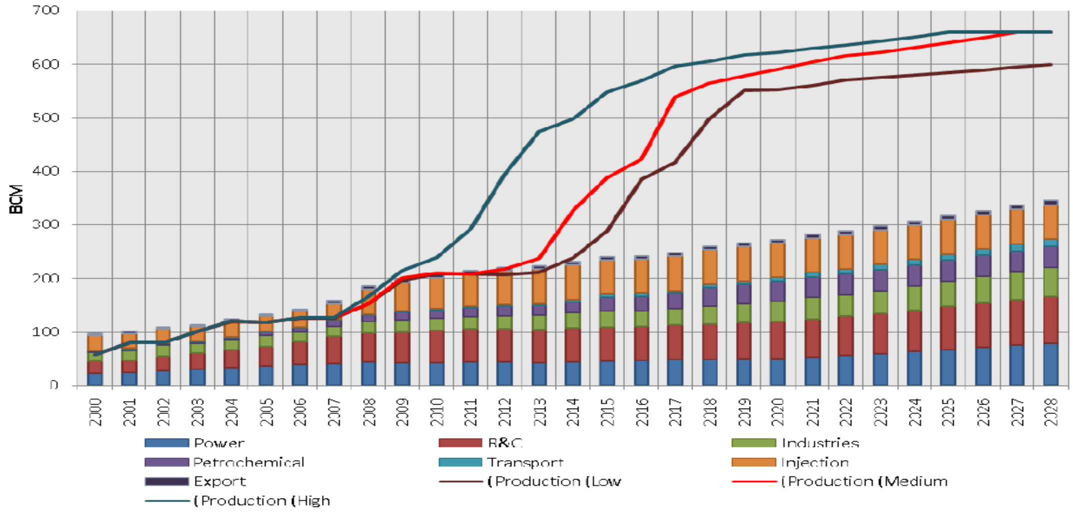
This “gray scenario” goes towards normalisation before the middle of the current decade.

- High Production Scenario (optimistic): Rapid increasing of foreign and domestic investments due to a sudden boost in Iran’s economic and political climate (Hariri et al. 2011: 4). According to this “white scenario”, after long and difficult negotiations, an agreement is found on the nuclear dispute very soon and unexpectedly. Under these conditions, the Western powers, especially the US, agree to lift sanctions completely. As a result of breaking this isolation, Iran could attract tremendous new foreign investors and ventures for its natural gasand LNG industries.

The above–mentioned scenarios, with three brown, red and blue lines in the diagrams below, are accompanying domestic low, medium and high gas consumption cases.

As can be seen in figure 51, issued by Idam Consulting Group, based on Iran’s different ministries’ and organizations’ official data, if this country’s gas demand were to maintain low levels and prevention measures for curbing excessive consumption, like dramatically reducing the level of governmental energy subsidy since December 2010, were to be implemented well, the country will experience surplus gas production from around 2013. The amount of excess gas in the low, medium and high supply scenarios will reach 45 bcm, 155 bcm and 300 bcm in 2015 and 260 bcm, 320 bcm and 330 bcm in 2025, respectively.

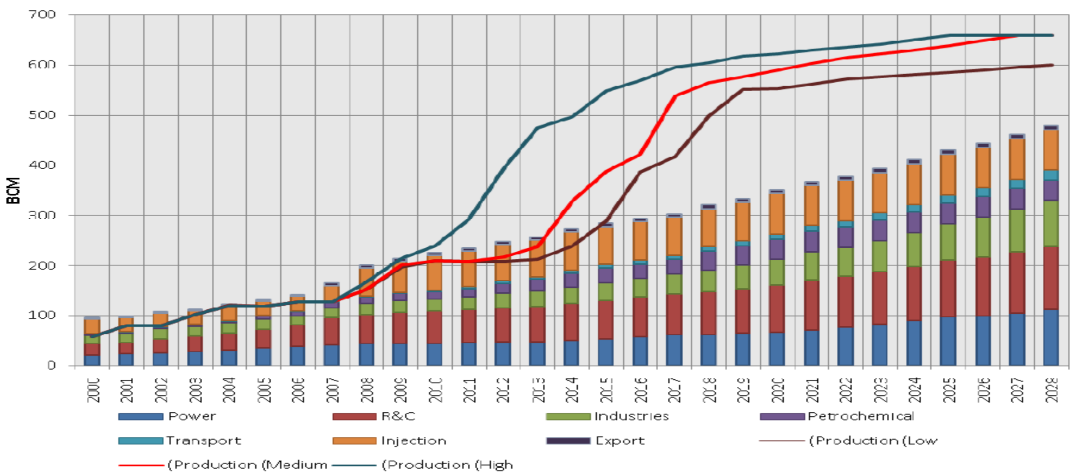
Figure 51: Iran's low domestic demand vs production scenarios



Source: Hariri et al. 2011, Idam Consulting Group: 19

Regarding Iran's medium domestic demand with three low, medium and high production scenarios, as figure 52 clearly illustrates, if this country's gas demand were to increase at a moderate pace, and prevention measures implemented in line with the 20–Year Outlook Plan (2005–2025), so the country will experience surplus gas production from 2014 and the amount of excess gas in the low, medium and high supply scenarios will reach 0 bcm, 155 bcm and 270 bcm in 2015 and 115 bcm, 210 bcm and 230 bcm in 2025, respectively.

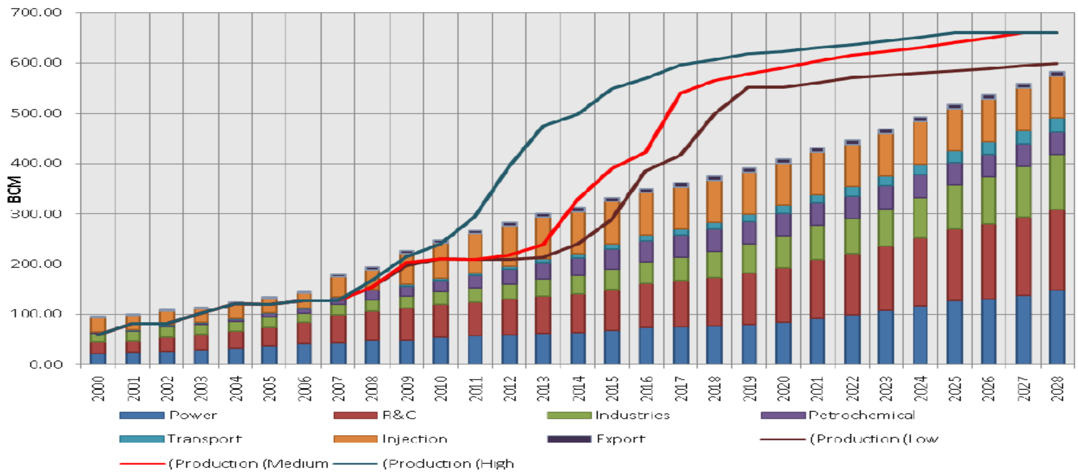
Figure 52: Iran's medium domestic demand vs production scenarios



Source: Hariri et al. 2011, Idam Consulting Group: 20

The high demand scenario is based on the assumption that the government does not implement any prevention measures and gas consumption will increase at a fast rate over the next 15 years, so according to figure 53, the country will experience surplus gas production as of 2014. The amount of excess gas in the low, medium and high supply scenarios will reach 0 bcm, 50 bcm and 205 bcm in 2015 and 65 bcm, 120 bcm and 140 bcm in 2025, respectively.

Figure 53: Iran's high domestic demand vs production scenarios



Source: Hariri et al, 2011. Idam Consulting Group: 21

What could be analysed on the basis of different sources, such as communication with Iranian and non–Iranian energy officials and scholars, is that, since December 2010, Iran's government has fulfilled the legislation passed by Majlis over the modification of consumption patterns, as well as the steady reduction of governmental energy subsidy by 2015, so domestic consumption has been dropping since 2011 (BP Statistical Review of World Energy, June 2011). On this basis, Iran's high domestic demand could be contained.

As Iran's Energy Policy has been based on shifting to gas from oil, since the 2000s (Crane et al. 2008), and the number of gas subscribers has increased, this trend will be maintained in the future (Shana Energy News Agency, 19.10.1390), so the low demand scenario in Iran in the coming years would be unlikely to materialise.

Consequently, Iran's medium domestic demand and above–mentioned "gray scenario" will remain in the short– and mid–term, while internal gas demand would increase, and prevention measures are implemented in line with the 20–Year Outlook Plan (2005–2025). So the country will have excess production between nil to 270 bcm/y in 2015 and 115 up to 230 bcm/y in 2025 and will be close to the medium case scenario in both supply and demand.

As Iran is the fourth gas producer worldwide and the Middle East's largest gas producer (US EIA 2011: 52) hence, production will increase in the future (Oil & Gas Directory Middle East, 2011: 1075; Oji, 29th July 2011: 5). Therefore, this country's production rate will not be low; instead it would be at least at a moderate pace. As a result, Iran would be able to have extra gas production from between 155 to 270 bcm/y in 2015 and 210 up to 230 bcm/y in 2025.

Iran must pay attention to the rise of its gas production in conjunction with a fall in consumption. These statistics clearly show that the gap between Iran's gas production and domestic consumption could be significant in order to increase exports in line with the 20–year energy outlook by 2024.

Nevertheless, Clément Therme (interview, 2012) mentioned the importance of foreign investment. He believes Iran holds huge gas reserves and even its domestic consumption would be upward, but the significant increase in foreign investment would enable the production surge for exports to be faster than domestic consumption.

Iran's natural gas and LNG exports potential could only be realised by 2020 if the problems of large domestic consumption, massive gas reinjection requirements (Elkind, 2010: 131) and lack of access to capital are resolved, while some of these steps are about to be taken, like sharp decrease of energy and gas governmental subsidy. Hence, a general concern is Iran's ability to adhere to project timetables and the access to required technologies, given the sanctions and diplomatic pressure being orchestrated by Washington in such a globalised energy market (Bahgat, 2011: 82). So, the most important issue to be solved is the nuclear dossier, as the biggest foreign policy challenge facing Iran since 1979 (Mousavian, 2008: 7&8).

On the other hand, some believe that sanctions not only prevents the major economic reforms in Iran from taking place but will also delay rapprochement with the West (Molavi & Shareef, 2008: 7). The issue of sanctions will also serve to unify the Iranian public against the Western policies, and make these sanctions counter–productive (Sadeghiani, 2012: 175–190). Despite some crippling results, this tendency has led to some progress in Iran, such as in gasoline industry. Although, almost 70% of Iran's total hydrocarbon imports in recent years was gasoline, but after the US' sanction on any gasoline exports to Iran in 2010, Tehran expanded its gasoline production and even planned to construct some new refineries. Therefore, it could result in Iran becoming a gasoline exporter around 2015 (http://www.eia.gov/countries/IRI). As a result, despite efforts to isolate or contain Tehran, the country has taken some huge steps towards (Ehteshami, 2012: 120–129) becoming a regional power, according to Samuel Hantington (Huntington, 1999; Peimani, 2012) with its political influence and geo–political weight (Ehteshami, 2012).

Needless to say that Russia observes Iran as a huge competitor for gas export toward the EU, according to Clément Therme (interview, 2012), while Prof. Geoffrey Kemp, in "Asianisation of the Middle East" Conference which was held at Durham University, in the UK, on 13th Sep 2012, described Iran's gas reserves, plans and outlook as the "Russian huge nightmare".

Therme added that Moscow has not got any interest to support the rapid development of Iran's gas industry to export to the EU, except in the event that future Iranian gas supply would otherwise be directed, mainly, towards India and China.

Another way is that Iran could send its piped gas to Russian customers in Central Asia, like Armenia and Georgia, whereas Moscow continues supplying to Iran's potential European importers, of course, by pipeline. So, Tehran could send its LNG to the European gas market in the future, rather than piped gas (Usefi & Naderian, 2011: 229).

4.3.6. Islamic Republic of Iran and the EU energy relations, background and perspective

A part from the US, Iran's historical ties with several European countries and geographical proximity, led to complicated relations with the EU (Bahgat, 2010). Shortly after the end of the Iran–Iraq war (1980–8) under the pragmatist presidents Rafsanjani and Khatami by the policy of detente, this approach led to immediate response by the EU countries in 1990s and then economic sanctions against Iran were removed (Takeyh, 2009: 5). In other words, in the 1990s, based on new geo–political realities, the Islamic Republic's foreign policy moved towards a closer relationship with its Eurasian hinterland, including the EU, Russia, China, and Central Asia (Ehteshami, 2009: 324–349).

Meanwhile, unlike the US' confrontational approach, the EU adopted a policy based on engaging the Islamic Republic, commenced by "critical dialogue" in December 1992 (Minkova, 2011: 7), based on diplomatic discussion and economic incentives, which led to Anglo–Iranian relations (Takeyh, 2009: 143–144) and this was then followed by "comprehensive or constructive dialogue," more effective than the American's Dual Containment policy against Iran and Iraq (Sabet–Saeidi, 2011: 55–73).

The European Commission and Iran formed a working group on energy in May 1999 and the two parties created another working group to deal with trade and investment issues and thereafter Tehran was invited to participate in INOGATE[6]. As a consequence of their energy security interdependence with Iran, the EU member states have initiated energy investment and cooperation with this country, like the development of the South Pars by France's Total, Norway's Statoil–Hydro, the Dutch–British Shell, and Spain's Repsol. On 17th June 2002, the Council of the EU agreed on opening negotiations with the Iran for a Trade

[6] INOGATE, originated in 1995, is an energy cooperation programme between the EU and the littoral states of the Black and Caspian Seas, as well as their neighbouring countries, with the exceptions of the Baltic States and the Russian Federation.

and Cooperation Agreement (TCA), however the EU suspended negotiations for more cooperation with Iran in September 2003, when Iran resumed its nuclear activities (ec.europa.eu/trade).

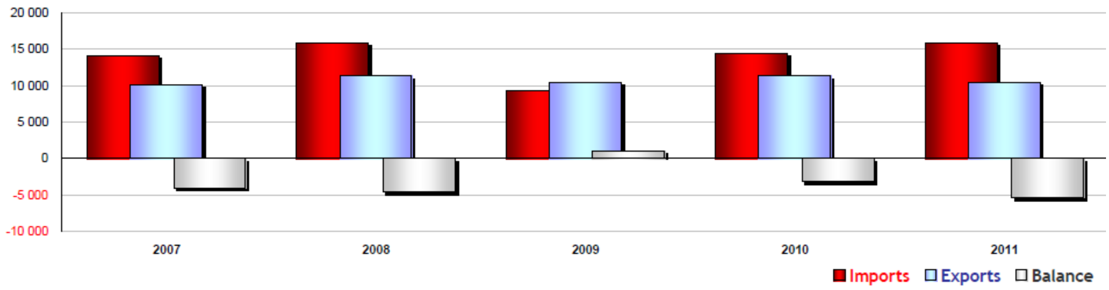
The EU approach regarding Iran was softer than the US (Th. Drenou, 2011: 73–84) so, the US pressurised the EU by way of economic sanctions against Iran, banned any foreign investment of more than $40 million per year in oil and gas projects. Some pointed out that EU's energy security contradicts with its nuclear diplomacy against Tehran (Young, 2009: 70). Nonetheless, European companies continued to invest in Iran, replacing American investors in Iran and making American sanctions ineffective (Sabet–Saeidi, 2011), for example, the French company Total replaced the American company Conoco with a $2 bn contract with The Iranian National Oil Company, in the South Pars (Th. Drenou, 2011: 73–84). The ILSA was the second phase of American sanctions against foreign companies investing in Iran's petroleum sector in Iran in 1996, while nearly 80% of EU imports from Iran in recent years have been hydrocarbon products. However, the EU responded with strong legislation preventing European companies and citizens from complying with ILSA (Sabet–Saeidi, 2011).

Since President Ahmadinejad came to power and with his stance regarding Iran's nuclear activities and the Holocaust after 2005, these relations, particularly with the three big EU nations, Germany, France, and the UK have been damaged (Mousavian, 2008: 190). This attitude has made the Union change its policy more towards the US' approach regarding Iran (Sabet–Saeidi, 2011) leading to some harsh decisions, like significantly decreasing oil imports from Iran since July 2012.

Seemingly, the post–election events in Iran in June 2009, to some extent, and failure to understand the recent changes in the socio–political landscape in this country, such as the "Green Movement", led to the loss of a number of opportunities and more mutual mistrust and suspicion about some controversial issues, like Tehran's nuclear activities (Sadeghiani, 2012: 175–190).

The EU is a strategic partner for Iran (Sabet–Saeidi, 2011) and Tehran's largest trading partner (figure 54), accounting for a third of all Iranian exports 90% of which are energy related. So, this country is the EU's 6th largest energy supplier (http://ec.europa.eu/ trade), as a result any harsh relationship between these two partners would be rather expensive (Ehteshami & Zweiri, 2011: 141–155).

Figure 54: The EU's trade balance with Iran



Source: European Commission DG Trade (2012), "EU Bilateral Trade With Iran", 27th March: 3

The European companies have shown growing interest in developing Iran's oil and gas resources, such as Norway's Norsk Hydro, the Spanish Ansaldo Energia, Italy's Einmeccanica, Germany's Steiner Prematechnik Gastec, Austria's OMV AG, and Switzerland's EGL (Bahgat, 2010). For instance, in April 2007 OMV AG, a leading partner in the Nabucco project, signed an $18 bn deal with Iran and in March 2008 the Swiss energy group EGL signed a 25–year deal with the National Iranian Gas export Company to deliver 5.5 bcm/y of natural gas (Tehran Times, 18th March, 2008).

The United Nations Security Council, as well as the US' sanctions against Iran followed by Foreign Affairs Council in its 3142th meeting in Brussels on 23rd January 2012 after the European Council's decision on 9th Dec 2011, leading to adoption of a package of new measures, including oil embargo, sanctions on the petrochemicals industry and a partial freezing of the assets of the Central Bank of Iran (www.ec.europa.eu/trade). However, the European energy companies have found themselves under political pressure, on the one hand and to develop a country rich in oil and resources and lucrative business on the other, so they have had to postpone their involvement to later phases of the South Pars development (Bahgat, 2010), as Jeroen van der Veer, the chief executive of Shell, indicated in referring to this challenge: “We have a dilemma. Iran’s oil and gas reserves are too big to ignore, but we have all the short–term political concerns.” (New York Times, 13th February 2007).

At present, Iran is not a major supplier of natural gas to the EU, but could be a reliable oil and gas provider for the EU, according to Iranian Foreign Minister Ali–Akbar Salehi (Xinhua News Agency, 21.02.2012, Tehran) and this situation for the country between the Persian Gulf and the Caspian Sea will not remain minor forever; Iran will be a major player in the medium term (Friedemann, 2003: 68). So, Simon Henderson, Director of the Persian Gulf and Energy Policy Programme at the Washington Institute for Near East Policy, highlights “the EU’s increasing interdependence with Iran” (Henderson, 2007; Friedemann, 2003) given the increasing natural gas and LNG needs around 2015 in the EU (LNG Journal, April 2008) and some other issues, like more diversification of natural gas routes away from Russia (Sajedi, 2009: 77–89). On the other hand, according to Howard Rogers (interview, 2012) engagement with the EU member states in natural gas and LNG trades could diversify Iran’s export routes and create a “more open and progressive stance on the part of Tehran towards economic and political engagement with the biggest regional organization”, while, it should be based on, bilaterally, the best interests and confidence building measures, such as in the 1990s (Moradi, 2006: 184), leading to “promote stability in the global energy market and economic prosperity to all concerned parties” (Bahgat, 2010).

El–Katiri (interview, 2012), argues that “the EU’s gas interests on a commercial side are in line with Iran and more natural gas and LNG exports from Iran is a win-win situation for everyone if political hurdles, especially nuclear conflict, can be overcome”.

Iran could assume an important role in the supplying of natural gas toward the EU in the future (US EIA, 2007), as the EU does not take advantage of a shortage of Iran’s gas capacity, while the Asian markets attract most of the global LNG (Peimani, 2012). This requires that Iran’s relations with the EU and the US should be normalised and that the political issues would be resolved.

Peimani also argues that any cooperation with Iran will be necessary for maintaining peace, security and stability in the Middle East/Persian Gulf and even Central Asia, also being important for the EU, politically and economically, while Rogers believes (2012: 168–174) that "the Persian Gulf region in general and Iran in particular, will be the sustained focus of ultra–regional powers over the next two decades". This interdependence necessitates that both Iran and the EU pay more notice to bilateral relations, as Bahgat (2010) indicated that the there are not any permanent enemies or friends; rather, energy can be seen as an area where Tehran's and Brussels' interests converge.

Dr. Mousavian, from the University of Princeton, in the US and the Iran's former senior nuclear negotiators proposed a "permanent working group" creation with the structure of a Steering Committee to lead the Iran–EU oil and gas issues, such as technological cooperation, investment, etc, to extend to more areas (Mousavian, 2008: 239–241). Nevertheless, Bahgat, (interview, 2012) emphasised this important point that natural gas, like oil, is a "political commodity", and so, on this basis, "energy could not be separated from policy and, consequently, there is no way to predict what will happen in Iran by 2020".

4.4. Geo–politics of natural gas in Qatar

The State of Qatar is an Arab country located on the north–eastern coast of the Arabian Peninsula and is bordered by Saudi Arabia in the south and the Persian Gulf on the north, east and west with a total surface of 11,586km^2 and is inhabited by approximately 1,951,591, based on the July 2012 estimation, (CIA library publication) with the highest per capita income in the world. According to the Oil and Gas Journal, as of January 2012, Qatar's natural gas reserves capacity has declined from 895,800 bcf in 2011, 13.5% of total deposits worldwide, to 890,000 bcf in January 2012, 13.3% of the world's reserves (table 21).

Qatar Petroleum (formerly known as Qatar General Petroleum Corporation), was founded in 1974, by its subsidiary, the Gas Operations Department, as the main body responsible for all upstream, midstream and downstream activities in the oil and gas industries (Qatar Petroleum, 2011, " Development of …": 13).

Associated gas, moreover, is produced from the off–shore Maydan Mahzam and Bul Hanine fields, which began production in 1965 and 1972, respectively and also in Shargi Dome (North and South), Al–Shaheen Field, Al–Khaleej Field, Al–Rayyan Field, and Al–Karkara with the help of overseas companies (map 5) (Qatar Petroleum, "Corporate Profile": 2), while non–associated gas was produced from the off–shore fields in the early 1970s when the giant North Field was discovered in 1971. In 1978, Qatar began to collect non–associated gas from the on–shore Khuff reservoir in the Dukhan area, located 84km, west of the capital Doha, to meet growing domestic demand and also as a back–up in case of gas shortage (Qatar Petroleum, 2011: 27). So, local demand was met first, and the rest delivered to Qatar's first LNG plant at Ras Laffan in 1997 (M. Wietfeld, 2011: 216). Ras Laffan City, along the northeast coast of Qatar, wholly owned by state–owned Qatar Petroleum, began operations in 1996 and enabled the production of LNG to send to the global markets, particularly the Far East and Europe. This port was developed to exploit Qatar's vast gas reserves in the North Field, as the largest global non–associated natural gas field which was operated by the Qatar Petroleum and which lies 80 km off–shore from Ras Laffan with six LNG facilities (map 10). It covers an area of 6,000km^2, equivalent to about half of Qatar's land area. The first commercial exploration of the North Field gas resource started in late 1991 with initial gas production from the North Field Phase 1 Alpha project (NFA) (Qatar Petroleum, 2011: 27).

4.4.1. Qatar's gas and LNG strategy and plans

Doha's Gas Strategy emerged and aimed to shift from oil to gas, basically LNG from the second half of the 1990s, because of the following reasons:

- ✓ Relative stability in the Persian Gulf after the Iran–Iraq war (1980–1988) and Iraq's attack to Kuwait in 1990;
- ✓ Some problems in Qatar oil industry, such as price fluctuation in 1982 and 1983 and its impact on domestic progress, and also Oil International Companies' dissatisfaction with Qatar's services;

- ✓ Current King's approach, based on natural gas preference, contrary to the previous monarch, subsequent to coming to power with a bloodless coup in June 1995;
- ✓ Qatar's goal aims to reduce Saudi Arabia dominance on Sheikdoms and the GCC and also more independent foreign policy by shifting from oil to natural gas and LNG, especially after Riyadh's disagreement with passing Qatari gas pipeline via its territory to Kuwait (Dargin, 2008: 1);
- ✓ Broader relations with Eastern and Western powers, particularly the US by the new LNG industry (Hashimoto et al. 2006: 234–268).

Hence, Qatari officials resolved this country's boundary disputes with its neighbours in GCC, such as the United Arab Emirates and Oman, Saudi Arabia and its differences with Bahrain over the Hawar Islands since May 1999 to December 2003 (Hashimoto et al. 2006: 234–268).

Qatar Petroleum plays a dominant role in upstream and downstream natural gas and LNG sectors with the help of some Oil International Companies, like ExxonMobil, Shell, and Total and owns and operates within the Dukhan, Maydan Mahzam and Bul Hanine fields, while the remaining off–shore fields are operated by the International Oil Companies via the Production sharing agreements (www.eia.gov/countries/Qatar). Nevertheless, Qatar Petroleum has maintained a majority share in most of its LNG projects by Qatargas and RasGas LNG Company Limited 'RL'. RasGas is 70% owned by Qatar Petroleum, as well as 30% by ExxonMobil, and acts as the operating company on behalf of the project owners, while the QatarGas consortium includes Qatar Petroleum, Total, ExxonMobil, Mitsui, Marubeni, ConocoPhilips and Shell. Nevertheless, Qatari officials have attempted to get access to the modern technology and attract the required investment by EPSA and ADPSA with these overseas firms (Qatar Petroleum, 2011: 22).

Map 10: Qatar's Oil and gas infrastructures

Source: Country file, Qatar, MOE's Report, December 2011: 9

RasGas and Qatargas have 14 LNG trains currently online and five of which were added in 2009 and 2010, with a total LNG liquefaction capacity of 3,770 bcf/y, around 77 MMt/y, according to Dr. Mohammad Bin Saleh Al–Sada, Minister of Energy and Industry, Chairman of Qatargas (The pioneer, May 2011: 3) that was exported from Ras Laffan Port, as the largest LNG harbor, all over the world in 2010 and 2011 (Qatar Petroleum, 2011: 38 & 49), while this port could increase its current export capacity up to 140 mmt/y (Davidson, 2012.: 38).

RasGas, founded in 1993, with around 120 gas wells from 14 platforms (Rasgas Magazine, Issue 23: 9) operates seven LNG production trains with the total production of LNG around 37 MMt/y (table 19) and developed world–class facilities for extracting, storing, processing and exporting LNG (Qatar Petroleum, "Corporate Profile": 5).

Qatargas Operating Company Limited was founded in 1984 to develop and process natural gas from the North Field, while its Qatar LNG Company, established in 2001 to produce LNG for export by Qatargas I–IV projects located off–shore about 80 km north-east of Qatari territory. Qatargas involves seven production trains for liquefying natural gas with a total capacity of 42 MMt/y of LNG (table 19), which is exported to the major markets in Asia, Europe and the US (Qatar Petroleum, 2011, "Development of …":50).

Table 19: Qatar's LNG infrastructure, January 2011

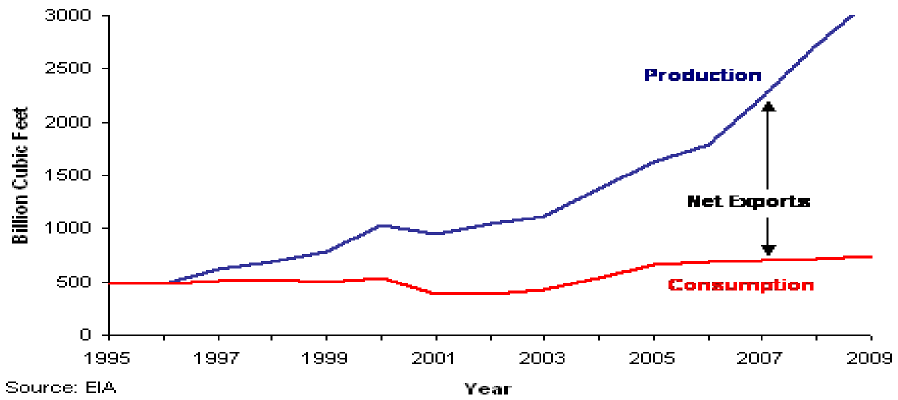
Unit	Liquefaction Capacity	Start-up	Primary Market(s)
RasGas Facilities			
Trains 1& 2	2 x 3.2 MMt (320 Bcf)	Aug. 1999	South Korea
Train 3	4.7 MMt (230 Bcf)	Feb. 2004	India
Train 4	4.7 MMt (230 Bcf)	Aug. 2005	Europe
Train 5	4.7 MMt (230 Bcf)	Nov. 2006	Europe & Asia
Train 6	7.8 MMt (380 Bcf)	Jul. 2009	Asia, Europe & N. America
Train 7	7.8 MMt (380 Bcf)	Feb. 2010	Asia, Europe & N. America
QatarGas Facilities			
Trains 1-3	3 x 3.2 MMt (480 Bcf)	Dec. 1996	Japan & Spain
Train 4	7.8 MMt (380 Bcf)	Apr. 2009	UK, Europe & Asia
Train 5	7.8 MMt (380 Bcf)	Sep. 2009	UK, Europe & Asia
Train 6	7.8 MMt (380 Bcf)	Nov. 2010	Asia & N. America
Train 7	7.8 MMt (380 Bcf)	Mar. 2011	Asia & N. America

Source: The US EIA at:// http:www.eia.gov/countries/cab.cfm?fips=QA

Qatar Gas Transport Company Ltd., known as Nakilat (carriers in English) was established in 2004, operates and manages 54 LNG vessels, the largest owners of vessels worldwide and aims to transport LNG to different areas (Qatar Petroleum, 2011, " Development of …": 54 & 55).

However, Qatari officials have noted that they do not anticipate building any more LNG facilities in the near future, and Qatar Petroleum would resist calls for new orders until at least 2015, while the existing plants could produce 12 MMt/y of LNG production capacity from its existing trains which already produce 77 MMt/y (figure 55), based on Qatar Petroleum's manager for gas development, Khalid Mohammed Hamed Al–Hitmi (Platts, 4 July 2011: 25). Nevertheless, Ledesma (interview, 2012) argues that "Qatar will not build any new facilities as it seeks to develop its domestic industry with gas in the future", hence, according to Bahgat (interview, 2012), Doha has frozen any new natural gas and LNG deals and has sought to assess its production, domestic needs, as well as export policies.

Figure 55: Qatar's gas production and consumption, 1995–2009



Source: The US EIA at:// http:www.eia.gov/countries/cab.cfm?fips=QA

Moreover, Qatar has no urgent need for additional revenues, since it already has the world's highest Gross Domestic Product (GDP) per capita ($92,000), according to the International Monetary Fund, World Economic Outlook Database, October 2009.

Qatar Petroleum with ExxonMobil, has also worked to develop LNG import terminals in several European countries (Dargin, 2008: 51), such as in the regasification capacity in the framework of Qatargas II Project in Milford Haven in Wales, in the UK under the long–term supply agreement (Wicks, 2009: 98) and also RasGas II terminal in Belgium, as well as Poland's invitation from Qatar to be a partner in a regasification terminal project in the Baltic Sea which is set to be commissioned in 2014 (M. Wietfeld, 2011: 218& 219).

In addition, the 364 km–long Dolphin Project, which reaches a maximum underwater depth of 50 metres and as the only gas network in the Persian Gulf region, has exported nearly 21 bcm/y natural gas (Hashimoto et al. 2006) from the Qatari North Field to the United Arab Emirates since July 2007 and Oman from October 2008 that brings together three member states of the GCC (Qatar Petroleum, 2011, "Development of …": 57) and also may possibly include Pakistan in the future (Hashimoto et al. 2006).

Turkey signed an agreement with Doha in August 2009 so as to participate in the Nabucco pipeline and Pakistan, in addition to Bangladesh, are looking to import LNG from Qatar (M. Wietfeld, 2011: 218& 219).

In addition, the fate of ambition to provide a gas pipeline between Qatar and Israel, having risen since the middle of the 1990s, would be uncertain, because of the peace process between Tel Aviv and Palestinians (Hashimoto et al. 2006).

4.4.2. Qatar's National Vision 2030 Document and its natural gas and LNG outlook

Based on "Qatar's National Vision 2030 Document", approved by an Emiri Decision in 2008 with four interconnected pillars including, Human, Social, Environmental, and Economic Developments (Qatar National Vision 2030, 2008: 11), simultaneous with the implementation of "Qatar National Development Strategy 2011–2016" (Rasgas Magazine, Issue 34: 7), the wise management and long–term maintenance of the strategic hydrocarbon reserves (Qatar National Vision 2030, 2008: 24 & 28) alongside balance between deposits and production, as being essential for Qatar's interests (Rasgas Magazine, Issue 23: 8) have become a primary goal for the country's sustainable development (Qatar National Vision 2030, 2008).

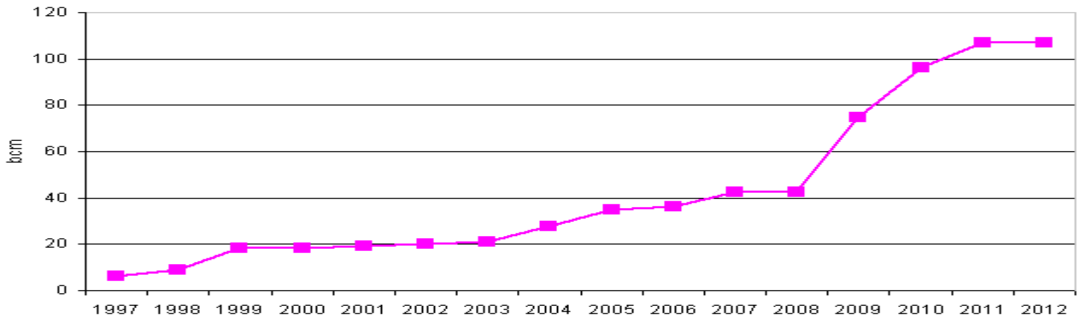
As Qatar's growth has accelerated, the demand for energy in this country has more than doubled since 2000 (BP Statistical Review of World Energy, June 2011: 27) while Qatar is the fourth largest gas consumer in the Middle East/Persian Gulf (IEA, Natural Gas Information 2010) and attempts to put an end to the enormous subsidisation of local energy prices as it aims to increase conservation (M. Wietfeld, 2011: 225), but this internal gas consumption will increases faster in the future (Rasgas Magazine, Issue 34: 5).

Qatar's principal gas project to meet growing domestic demands is the development of the Barzan field at Ras Laffan Industrial City by a partnership of Qatar Petroleum (93%) and ExxonMobil (7%), which started on 20th February, 2007. It envisages that the trains 1 and 2 would be online by 2014 and 2015 (http://www.rasgas.com), with production of approximately 1.4 bcf/d of natural gas (Qatar Petroleum, "Corporate Profile": 6) and will push Qatar's production up to about 23 bcf/d gas from the North Field, equivalent to more four million barrels of oil (Rasgas Magazine, Issue 34: 11). The project has the potential of maximizing up to 6 trains to use Qatar's infrastructure plans in transport, health and education, industry growth (Oil and Energy Trends, October 2011: 7–8), power and water sectors, as well as new airport, sea port and facilities for the FIFA World Cup in 2022 (Rasgas Magazine, Issue 34: 5&8), while RasGas will operate this project on behalf of the two shareholders. This project, according to Dr. Mohammed Bin Saleh Al–Sada, Minister of Energy and Industry and Chairman and Managing Director of Qatar Petroleum, as well as RasGas Company Limited, is a catalyst for the future development of Qatar (www.qp.com/mediacentre, 22nd December 2011).

The Al–Khaleej Gas (AKG) project, established in 2000 and adjacent to RasGas Trains 3 and 4, is another Qatari project to develop the North Field gas reserves and produce 2 bcf/d for use in the local market that, as in the first plant, AKG–1, came on stream on 2nd November 2005 at Ras Laffan Industrial City, and the second leg of the project, AKG–2, started up in late 2009. The project is undertaken by ExxonMobil Middle East Gas Marketing Limited and under the operation of RasGas Company Ltd. (Qatar Petroleum, 2011, "Development of …":60).

Although Qatar began exporting LNG only in 1997 to Japan, heavy government emphasis on this sector, both in terms of making investments and attracting foreign investors contributed to the rapid development of Qatar's LNG capacity. As a result, since 2006, Qatar has been the largest LNG supplier in the world (MOE, 2010: 2; www.eia.gov/countries/Qatar) with 3,154 bcf/y in 2009, three times more than the 2000's production and 4,121 bcf /y in 2010 (figure 56), while its domestic consumption (figure 20) in 2009 and 2010 was 745 and 770 bcf relatively (http://www.eia.gov/countries/Qatar) through the interconnected 2,200 km–long gas pipeline network with more than 50 distribution stations (Qatar Petroleum (2011), "Development of …": 30).

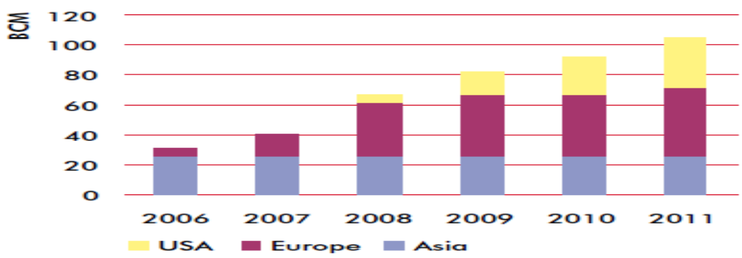
Figure 56: LNG production capacity of Qatargas and Rasgas



Source: Qatar National Bank

The Ministry of Foreign Affairs defines this leadership in the LNG supply as the key policy goal for the government in the future (European Commission, Qatar Country File, 2011). As a result, economic policy is mostly focused on developing non–associated natural gas reserves (IEA, Natural Gas Information 2010).Moreover, Qatar's gas export has been more than doubled between 2008 and 2011 with its prominent geo–political position enabling Qatar to supply both Asia and Europe (Wicks, 2009: 98) and even South America, such as shown by a recent agreement between Qatargas and Argentinian oil and gas company Energia Argentina for the sale of 5 mmt/y of LNG from 2014, as the first 20–year long–term contract for South America (Platts, 4thJuly 2011: 25). Asian LNG markets, especially Japan, S. Korea, India, Taiwan and also the US market have imported more than 60% of Qatar's LNG in recent years (figure 57) under long–term contracts as well (http://www.eia.gov/countries/Qatar).

Figure 57: Qatar's LNG exports, 2006–2011



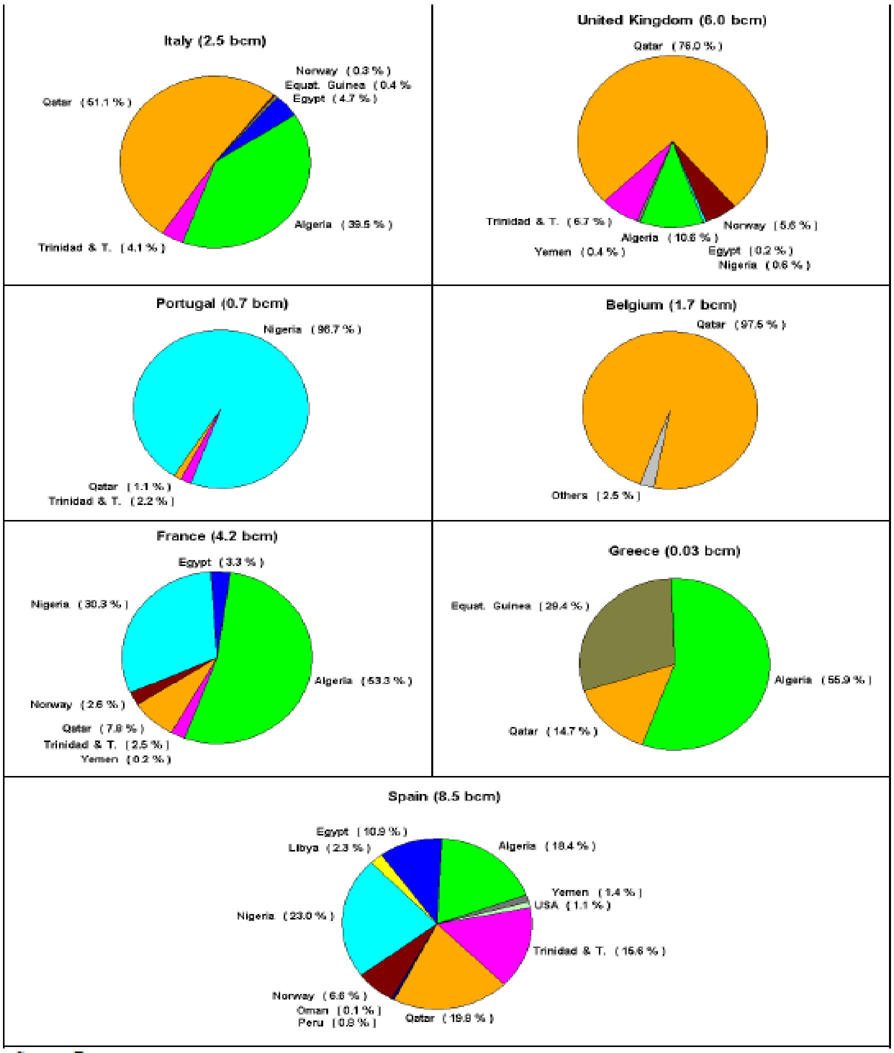
Source: Energy Tribune website

4.4.3. Qatar and the EU LNG relations

The EU's natural gas and LNG markets including Belgium, the UK, Italy, and Spain have been attracting around 33% of the Qatari LNG destination in recent years; most of them are under the spot contract (http://www.eia.gov/countries/Qatar).

By comparing the rates of the EU's LNG imports from Qatar in 2009 and 2010 (figures 58), it could be concluded that the EU's LNG imports from Qatar have dramatically increased during recent years, excluding Belgium which fell from 99% in 2009 to 97.5% in 2010, even though France, Greece, and Portugal joined the group of LNG importers from Qatar.

Figure 58: Structure of LNG imports of selected EU countries (2010)



Source: Country file, Qatar, MOE's Report, December 2011: 12

In 2010, 95% of Qatar exports to the EU were fuels, while 70 % of total EU imports originated from the GCC countries (European Commission, Qatar Country File, December 2011). As a result, most of Qatar's exports to the EU have been based on LNG supply in recent years and nearly all of the energy experts in their own essays, as well as interviews, insist that this gas relationship could broaden in the future, but it depends on seasonal conditions in the EU, the price which Qatar wants to charge, the economic situation in Europe, as well as distinguishing between term–contract LNG and spot LNG, while Qatar, unlike with Asia, is willing to send spot LNG to the EU, according to El–Katiri (interview, 2012), whereas Korine (interview, 2012) foresees that "in case of poor economic growth, the EU even might decide to abandon its focus on greenhouse gases emissions and thus turn to potentially lower–cost options for power, e.g. coal from Poland".

El–Katiri (interview, 2012) added that "Qatar is in no urge to further increase exports to the EU if its price will not be accepted in the framework of spot LNG; however, it is unlikely the current volume of LNG export will be lifted before 2015".

On the other hand, the US EIA predicts that the rate of Qatar's LNG exports will reduce after 2015, because of the current moratorium on further development from the North Field (US EIA, "Country Analysis Briefs: Qatar", January 2011), domestic needs for power generation, water desalination, as well as local industry (US EIA 2011: 61). Consequently, "there is no way to predict the outcome of this assessment over the amount of Qatari LNG export to the EU", according to Bahgat (interview, 2012).

Peimani (interview, 2012), believes "in the absence of the American gas market, becoming more self–sufficient in gas thanks to its shale gas industry, and the EU's growing natural gas demands, Qatar would be able expand its LNG export capacity to this huge region, like the current export level toward the Asia–Pacific market". Howard Rogers (interview, 2012) also added this point that "Qatar might raise its natural gas and LNG exports to the EU, if Australia expands its LNG supply and displaced some Qatari LNG back into the Atlantic basin".

Hossein Hassantash, Iran's former parliamentarian in the Energy Commission (interview, 2012) being in a negotiating team with some of the Persian Gulf states regarding gas interactions believes that "Qatar is going to have a considerable share in the EU gas market in addition to more venture in EU's LNG terminals, while this country has to export gas to some other sheikhdoms within the Persian Gulf, like United Arab Emirates, Oman, and maybe Bahrain and also should send more LNG towards the East Asian countries". This process shows that "Qatar is interested in diversifying its export markets, while decreasing the US' imports, Doha will maintain its huge gas export volume to the EU", based on Bahgat (interview, 2012).

Natural gas, as the clean–burning fuel, based on Qatar's Minister of Energy and Industry (Rasgas Magazine, Issue 34: 5),is about twice as clean to burn as oil, so its global demand is expected to increase by 50% over the next 25 years (US EIA 2011: 43; Qatar Petroleum, 2007, Issue: 1). This has resulted in most of the consumers, such as the new Asian players and also European LNG companies, starting negotiation with Qatar with the aim of importing from this country.

4.5. The role of the GECF in global natural gas and LNG markets by its Troika

Dramatic changes within the international gas markets are currently in progress, such as globalization of these markets (Huntington, 2009), rising shares of LNG trade (BP, 2011: 57), and spot contracts (IGU, 2010: 12), as well as increases in the prospects of unconventional gas supply (Potential Gas Committee, 2010; US EIA International Energy Outlook 2011: 50)

These developments impact on gas players, including exporters, importers, and even transit countries, and under these situations one issue is about the role and impact of any cartel, as well as establishing what are the positions of Iran and Qatar, as the second and third natural gas holders worldwide in the framework of this gas cartel.

There are some conditions in order to establish any cartel, including:

- ✓ The number of gas producers with the biggest share of global reserves;

- ✓ Production quota by gas producers;
- ✓ Any excess production capacity under gas producers' control;
- ✓ Any new gas producer as a member of this cartel or extra gas production weakens its capability (Soligo, M.Jaffe, 2006: 437–469).

There is a limited number of huge natural gas holders worldwide, enabling this gas cartel to controlled, the so–called GECF. It was set up as a forum in the first ministerial meeting in Tehran, Iran on 19th and 20th May 2001 with a few members from Europe, Asia, Africa and Latin America. Nevertheless, the international governmental organization's charter was approved in the seventh ministerial meeting in Moscow, Russian Federation on 23rd December 2008 (gecforum.org), when it was agreed to institutionalise their cooperation in gas and coordinate joint projects, through the establishment of the Big Gas Troika (Reuters, 21st October, 2008).

The 11–member GECF, holding more than 63% of global natural gas reserves (BP Statistical Review of World Energy, June 2011), while Iran, Russia and Qatar, as the three top global gas holders and this organization's members (Davidson, 2012), account for about 54% of the global natural gas deposits (BP Statistical Review of World Energy 2010: 22), represents the interests of gas producing nations and is occasionally described as the natural gas version of the OPEC. There have been some speculations about whether this entity would turn into the so–called Gas–OPEC, first proposed by Vladimir Putin (S.A. Gabriel et al. 2012: 137–152) and some expressed their strong support of the Russian president's suggestion, such as his Kazakh counterpart and Iranian officials (CNN, 02.02.2007).

It was formed with the purpose of exchanging experiences and information in gas–related matters, strengthening of collaboration and coordination among the member countries over the volume of gas exports, transportation, exploration, and further assistance to gas industry development (Information Booklet First Gas Summit, 2011: 16). This was in an effort to derive the most value from their gas resources (WGI, 2010), as well as more negotiations among the producers and gas consumers with the aim of encouraging more stability and security of supply and demand within the global gas markets with the objective of a fair price for both sides (www.gecforum.org).

However, the creation of a forum, such as this, raised concerns in many importing countries over the possibility that it might become a Gas–OPEC, behaving like OPEC, and restricting production in order to increase the gas price. For instance, gas company executives attending the conferences in Paris and Rome expressed their own concerns regarding GECF, while Guy Broggi, senior adviser to the Director of LNG at Total, said (Bloomberg, 15th Nov 2011) at the European Autumn Gas Conference (EAGC) in Paris on 15th and 16th November, 2011,"if GECF members link the price to OPEC crude oil, someone else is taking care of their interests", and Marco Arcelli, head of Italian utility Enel Spa (ENEL)'s Upstream Gas Division at the World LNG Summit in Rome on 14th to 17th November, 2011 argued that the EU should monitor the gas situation concerning imports that come mainly from Russia, Algeria and Qatar, as the main GECF's members (Bloomberg, 15th Nov 2011).

4.5.1. The challenges against a stronger GECF outlook

The GECF has some challenges on its way that should be considered in order to be more influential within the global arena:

- Different views among the number of GECF members regarding a range of issues, such as quotas of production, gas price (Cohen, 2009), and privatisation of gas industry in producers (Soligo, M.Jaffe, 2006). For instance, Abdoallah bin Hamad Al–attieh, the Second Deputy of Qatari Prime Minister addressed in the Institute for Public Policy Conference on 26th May 2006 that any Gas–OPEC would not emerge and his country will not attend this probable body and also this country's Energy Minister Mohammed bin Saleh al–Sada told a press conference in Doha (AFP, 13th November 2011) that it is not the duty of GECF to determine the gas price, however, Vladimir Putin, Russian President, in February 2007 described Gas–OPEC as a vital idea simultaneous with globalizing of the gas market (the Economist, 5th February 2007). As another example regarding quotas of production, according to Hamad Bin Khalifa Al Thani, the Emir of Qatar (Nigeria Energy Intelligence, 28th November 2011), “producers need to narrow the gap between prices for gas and crude oil without trying to limit production”. By contrast, Iran’s Oil Minister, called on the GECF to develop “a comprehensive market management plan” that would allow them to react to demand fluctuations by adjusting supply and quotas of production, leading to the best price (Nigeria Energy Intelligence, 28th November 2011). Algeria also prior to the GECF meeting in April 2010, called for coordinated cuts of gas production by members, but this was rejected at the meeting (WGI, 2010). Some believe that any cooperation among gas producers regarding quotas of production and the rise of gas prices can give rivals access to one another’s markets (Tuttle et al. 15th November 2011);

- Despite relatively high number of the existing members, a number of the minor gas producers will be marginalised by 2025 and then the market power of the bigger gas holders will be enhanced (Cohen, 2009);
- The US, Norway, Australia, the Netherlands and Canada hold a large amount of natural gas (EIA International Energy Outlook 2011: 64), but they are not interested in joining GECF, because of their relationships with developed countries, and the main natural gas and LNG importers and unconventional gas, particularly in the US (Soligo, 2006);
- The membership in both OPEC and the GECF with two complicated policies, hence, these members may seek to connect these two organizations’ policies with each other in the future (OPEC.org), so some of these members, particularly Middle Eastern ones, such as Algeria, Iran and Qatar might obtain further market power by coordination in the future (S.A. Gabriel et al. 2012: 137–152). Notwithstanding some similarities, the gas market has some characteristics that differ from the oil market. The former is more regionalised, unlike the more globalised structure of the latter, so globalised gas trade, rather than just

transportation within a region, is much more important, according to Clément Therme (interview, 2012);

- Energy market liberalisation and development of renewable energy sources, particularly during the next decade, are other impediments against the emergence of powerful GECF, because this policy leads to more rivalry between the producers and may cause to reduction of exporters' market power (Soligo, 2006).

4.5.2. How would the GECF become more powerful by its Troika?

At the moment, GEFC is characterised by different arguments regarding its future role and goals so, some believe that any powerful Gas–OPEC group would be difficult politically in the short–term (Cohen, 2009) and also with oversupply in natural gas and LNG, as well as a subsequent price decrease (S.A. Gabriel et al. 2012). There is also the likelihood that some other gas producers and exporters will enter the global gas market (Soligo, 2006), contrary to some arguments over the growing strength of the GECF in years to come. For instance, Russia supports this cartel and has emphasised in its "Energy Strategic of Russia Document up to 2030" (2010: 58), that this entity should control the gas price and production.

Robin Mills, head of consulting at Dubai–based Manaar Energy Consulting and Project Management, believes (Nigeria Energy Intelligence, 28th November 2011) "any oil–linked prices means high gas prices and could be an obstacle against gas–on–gas competition and transparent market–based pricing, and also the ability of gas exporters to control prices is limited by the fragmented nature of global supply and competition among producers". For example, the US' natural gas and LNG prices are lower than those in Europe, while spot LNG market prices in Europe are currently lower than those in long–term contracts based on oil prices, unlike in Asia, due in part to Japan's need to import more LNG after its nuclear power plant disaster this year (White, 11th Sepember 2011).

Since the beginning of the current decade, the January 2011 Japanese nuclear crisis, political uprisings in the Middle East, as well as rising of gas demands have impacted on the GECF and this was highlighted during the first summit of the head of the states on 15th November 2011 (Mashal, 22.03.1390/12.06.2011: 11).

The focus of GEFC is reportedly shifting towards LNG, while the members provide 85% of the world's LNG exports, but partly under long–term contracts. So, gas pipeline supply and this kind of contract, instead of spot contract, are the main obstacles against a strong GECF (Hurst, 2009: 271–282).

In addition, Russia, Iran and Qatar together hold about 54.3% of the world's natural gas reserves (Oil & Gas Journal, Jan 2011; EIA International Energy Outlook 2011: 64), hence their positions and the rise of LNG activity, especially in the framework of the spot markets, leads to increase of market power for Russia, Iran and Qatar and turns the GECF into an effective gas cartel (US EIA, 2008). Some also believe that the GECF members should discuss dividing international gas markets, like at the Doha meeting in 2008, particularly in Europe, where Russia and Algeria are major players already and Iran may join in future years (Cohen, 2008).

Accordingly, Iranmanesh (interview, 2012) says that, in order to be strong and effective in GECF, Iran must strengthen the infrastructures of natural gas, LNG, etc., and also complete and develop its liquefaction facilities, like Qatar.

Even though, unconventional gas and gas transportation, via pipeline or LNG, are two important parameters for the future gas market in the world (S.A. Gabriel et al. 2012). However, unconventional gas, that mostly produced by the US, could diminish the gas cartel's power (US EIA, 2008). For this reason, Leonid Bokhanovskiy, who became the secretary general of the GECF in December 2009, told National Journal on the fringes of a major energy conference believes that "this organization should negotiate more with the US Energy Department for more global coordination regarding gas issues, but the GECF has not yet asked the US to join this body".

The current regionalised trend is towards a more globalised gas market with more spot contracts that differ across the regions and this method could improve the GECF's position in the future (S.A. Gabriel et al. 2012).

4.6. Conclusion

The Middle East holds 40% of global natural gas reserves most of which is situated in the Persian Gulf region, while Iran and Qatar hold around 30% of the world's natural gas reserves or 75% of the Middle East deposits with the world's largest non–associated natural gas field. In addition, they have the lowest production and exploitation costs among the other natural gas holders worldwide, so these two countries together will be the third natural gas and LNG producers by 2030, after Russia and the US.

Gas produced from unconventional gas by the US and partially by Canada is a serious rival for conventional gas during the two next decades, while the former decreases its LNG imports. However, conventional gas preserves its dominance in the global gas market, so the percentage of unconventional gas production will rise from around 12.5% in 2010 to around 18% by 2030. In addition, gas production in some regions, like Europe, drops, some of the minor natural gasand LNG exporters will be eliminated during the coming years, and global consumption will rise. Despite that, the North America's unconventional gas and Australia's LNG productions will increase as natural gas consumption in these countries, particularly in the US rises to become the leading consumer worldwide by 2030, followed by Europe. Hence, the natural gas and LNG demand is expected to increase globally by 50% until 2030 and up to 90% in the EU. The world's LNG capacity, for instance, has been increased at 40% between 2005 and 2010, whereas it will nearly double by 2030.

In addition, unlike natural gas from Russia and the Persian Gulf, the least–cheap unconventional gas production has some environmental and financial problems in these countries.

However, unstable political environments and security challenges, such as tension concerning Iran's nuclear programme has led to intensification of the zero–sum game in the Persian Gulf region, while because of the geographical proximity and economic interdependence, they must attempt to solve these challenges and aim to attract more foreign capital for energy projects.

On the basis of Iran's "20–Year Outlook Document (2005–2025)", alongside "Iran's Grand Energy Strategy by 2023", this country plans to increase its current 1% share of gas global market to 8%–10% by 2023, so it follows some more regional pipeline projects and LNG plans must be both considered and constructed and, in the case of opening up of its first 4 or 5 LNG plans, Tehran will take its place in the top five LNG exporters by 2020. Nonetheless, foreign sanctions, preventing the required capital and advance technology for this country and high domestic consumption are the main hindrances against this target. As a result, the three main scenarios perceived concerning these two principal hurdles against Iran's natural gasand LNG projects and the volume of export, are Low, Medium, and High Production Scenarios. Given the prevention measures and the phasing out of energy subsidies in Iran, implemented by the government and the continuation of negotiations aimed at solving this country's controversial nuclear programme, it seems that Medium Scenario would be more reasonable. While internal gas demand would increase somewhat, the country will have excess production between nil to 270 bcm/y in 2015 and 115 up to 230 bcm/y in 2025 for export, particularly to Asian and European gas markets.

The States of Qatar's Gas Strategy, moreover, emerged and aimed to shift from oil to natural gas, and led to an increase in its LNG production capacity from its existing 14 trains up to 77 MMt/y and turned it in to the first exporter worldwide, and as an example, the EU's LNG import from Qatar has dramatically increased during recent years. As a result, the Ministry of Foreign Affairs defines this leadership in the LNG supply as the key policy goal for the government in the future. On the other hand, Doha has frozen any new natural gas and LNG deals and decided not to develop its LNG facilities, in number, in the future, while its domestic consumption has noticeably increased and this trend will continue in the future. Based on "Qatar's National Vision 2030 Document", simultaneous with the implementation of "Qatar National Development Strategy 2011–2016", the long–term maintenance of the strategic hydrocarbon reserves alongside the balance between deposits and production have become primary goals for the country's sustainable development. It seems that LNG exports will grow in the future, particularly toward Asia and the EU, rather than the US, but it depends on the seasonal conditions in the EU, the price which Qatar wants to charge, the economic situation in Europe, as well as distinguishing between term–contract LNG and spot LNG.

Simultaneous with the dramatic changes within the international gas markets, GECF was set up with the aim of coordination among the member states over the volume of gas exports, prices, more negotiations between the producers and consumers, etc.

However, this forum raised concerns in many importing countries over the emergence of a Gas–OPEC, while GECF faces other challenges to be solved in order to become stronger in the future. Some different views among the members, particularly the Big Troika, including high numbers of existing members and lack of more important producers, like the US, Canada, Australia, Republic of Azerbaijan, Norway (as a state on observer in GECF) in the GECF, production of gas from unconventional gas as a serious rival for conventional gas and, to some extent renewable energy sources, are the main challenges facing this forum. In addition, the GEFC is shifting towards LNG, while the members provide 85% of the global exports, so development of LNG facilities with spot contracts will make this body stronger. As a result, Iran must construct and develop its LNG projects, to at least 70% of the current planned capacity as soon as possible to assist its aims to reinforce itself as a regional and global market power, like Qatar.

Chapter 5: Analysis of the impacts of the energy security's indicators on the EU's LNG relationships with different suppliers

5.1. Introduction

Energy security and security of energy supply have been a significant concern during the past hundred years and will be the main anxiety for almost all countries worldwide during the 21st century. It has, moreover, got four regular indicators comprising, acceptability (environmental and social elements); availability (geological aspects); affordability (economic criterion) and accessibility (geo–political dimensions) and realization of these criteria could ensure security of energy supply.

This term had, traditionally, concentrated on crude oil supply, but since the 1990s, natural gas has increasingly become "the fuel of choice" and therefore, "Gas is the new oil".

Global natural gas demands will increase around 50% by 2030 and its share in the world's energy mix will rise from 21% in 2010 to 25% in 2030.

LNG, known as "the floating pipeline", has become more popular in recent years and according to some official stimations, more than 50% of global gas trading will be by LNG carriers by 2030.

The EU will the world's largest natural gas and LNG importer by 2030 and import around 80% of its demands after 2020. So, the share of LNG in the EU's gas market will rise from nearly 15% in 2010 to around 40% by the end of the next decade. As a result, diversification of LNG suppliers has also been at the top of the EU statements, particularly since the early 2000s. Therefore, the classification scheme of the core indicators of the energy security is the cornerstone for testing them on the EU's LNG relationships with different actual and potential suppliers, such as the Persian Gulf and then comparing them for ranking to clarify the most appropriate suppliers in the future for the Union.

So, the main questions in this chapter will be, as follows:

- How is the position of each actual and potential LNG supplier towards the EU in the global ranking, based on each of the sub–indicators of energy security?
- Which gas holder(s) could be the main LNG supplier(s) towards the EU in the future, on the basis of the energy security' indicators and sub–indicators?

5.2. Comparison of the main actual and potential LNG suppliers to the EU, based on the main indicators of the energy security

Natural gas can be transported either through pipelines or in liquid form on vessels, as LNG, known as "the floating pipeline" (Jaffe & Soligo, 2006: 437–468). The latter has become more popular in recent years because of the unlimited transportability by tanker (Sascha Muller–Kraenner, 2007: 8), flexibility in distance, volume, contract and also suppliers being more globalised, as well as the reduction in costs in the LNG value chain due to technological advances (Palm, 2007: 3).

According to official projections, gas demand will enhance at faster rates than other fossil fuels in the future (OPEC Energy Outlook 2011: 54; EIA, 2011: 43) and continues to be the fuel of choice in many countries and regions of the world (Luft & Korine, 2009: 555), because of its:

- ✓ Acceptability: its lower carbon intensity, compared to oil and coal, making it a clean fuel (Luft & Korine, 2009: 555) and an attractive fuel source in countries where governments are implementing policies to reduce greenhouse gases (EIA, 2011: 43);
- ✓ Availability: discoveries of gas fields are still possible, in addition to the current huge proven global reserves, and also unconventional gas resources to develop but albeit with some uncertainty (EIA, MOSES 2011);
- ✓ Affordability: its significant price flexibility (K. Sovacool & Lim, 2011: 417), alongside its low capital costs for power plants, due to the technological advances can lead to cost reductions (Palm, 2007: 3) with favourable

thermal efficiencies relative to oil (EIA, 2011: 43), simultaneous with the escalating of the oil price in recent years and also in the future (Luft & Korine, 2009: 555);

- ✓ Accessibility: its geo–political, infrastructural risks are less than those with oil and also with the capacity of diversifying of suppliers (K. Sovacool, 2011: 9; Checchi et al. 2009: 43).

5.2.1. Acceptability/Sustainability of natural gas and LNG

Global warming, air pollution and climatic changes, caused by greenhouse gas emissions, "make the current energy landscape unviable in the medium–to long–term" (Proedrou, 2012). Carbon dioxide, as "the chief greenhouse gas" remains in the Earth atmosphere for hundreds of years and some other gases stay for even thousands years (Borenstein, Associated Press, 31.05.2012). On the basis of some global summits and protocols, the main developed and developing countries must cooperate with each other to counter this dilemma. Alhajji, linking the environmental dimension of the energy securitydirectly to pollution issues, argued that, "to ensure energy security, governments should integrate their industrial and technology policies into their energy policies" (Alhajji, 2007d). Following the 1992 United Nations Climate Convention, the 1997 Kyoto protocol has expanded the decision–making process for climate–change policy. The latest attempt to solve environmental problems and reduction of greenhouse gasemissions on a global level was the Copenhagen summit in 2009, having resulted in the so–called Copenhagen accord. This demonstrates the idea of connection between environment and security, raised by the Copenhagen school, which identifies the environmental sector of energy (Buzan, Waever & Wilde, 1998).

On the basis of the Energy Security Unit, Joint Research Centrefor the European Commission(Costescu Badea, 2010: 4) environmental and social concerns are the two key elements for acceptability of any energy resource.

The IEA has classified some issues, relating to environmental dimension of energy security, such as the role of renewable energy sources and bio–fuels, energy efficiency, fossil fuels, technological progress (IEA, 2004) in order to achieve “green energy” (Proedrou, 2012) and lower the negative impacts of energy use upon the environment.

Global temperature continues to rise and ecosystems will cause more damage by the growing use of fossil fuels, principally coal and oil, unless the share of renewable energies in the energy mix increases and also cleaner fossil fuels are to be consumed (Proedrou, 2012).

According to the IEA, 2009 and BP, 2011 Energy Outlook for 2030, the global energy mix will change within the coming two decades. Oil and coal consumption is set to decrease, while natural gas and LNG demands will further increase owing to environmental and strategic/security reasons (R. Odell, 2002: 432). Natural gas, as a colourless and odourless material, (Palm, 2007: 7), is the cleanest of all fossil fuels without any production of sulphur dioxide and also it generates considerably less carbon dioxide (CO_2), toxic gases and carbon intensity per unit of energy, 40–50% less than coal and 25–30% less than oil (table 20). Methane’s poisonous emissions, as the primary component of natural gas, besides ethane, propane, butane, pentane and hexane (Palm, 2007: 7) are very low.

It is often found together with oil, known as associate gas, being separated from the oil and taken to the processing plant, while non–associate gas is originally without oil. So, the importance of natural gas, as the least carbon–intensive fossil fuel, is expected to increase (IEA, 2007: 492).

Table 20: Comparison of the fossil fuel's compositions

Elements	NG	LNG	Oil	Coal
Methane (CH_4)	70–90%	99.72%	Nil	Nil
Ethane (C_2H_6)	0–20%	0.06%	Nil	Nil
Propane (C_3H_8)		0.0005%	Nil	Nil
Butane (C_4H_{10})		0.0005%	Nil	Nil
Carbon (CO_2)	0–8%	Nil	83%–87%	65%–95%
Oxygen (O_2)	0–0.2%	Nil	0.05%–6%	2%–30%
Nitrogen (N_2)	0–5%	0.20%	0.1%–2%	1–4%
Hydrogen sulphide (H_2S)	0–5%	Nil	10%–14%	2%–7%
Neutral gas (Xe, Ne, He, A)	trace	Nil	Nil	Nil

Source: US' Geological Survey; G. Victor et al (2006), Natural Gas and Geo–politics, from 1970–2040; Wikipedia–the free encyclopedia; NaturalGas.org; Centre for Energy Economics (CEE)

The coal is composed of carbon, oxygen, hydrogen, nitrogen and sulphur, while the percentage of these elements differ in various types of coals, such as lignite, subbituminous, bituminous (65%–85% carbon and 5%–15% oxygen), semi–anthracite or hard coal (80%–85% carbon), as well as anthracite or hard and durable coal (85%–95% carbon), while these kinds of coal have hydrogen contents of 3%–6%.

The heavy, extra heavy, conventional and sand oils are, moreover, the main kinds of this hydrocarbon with different percentages of chemical elements (table 20).

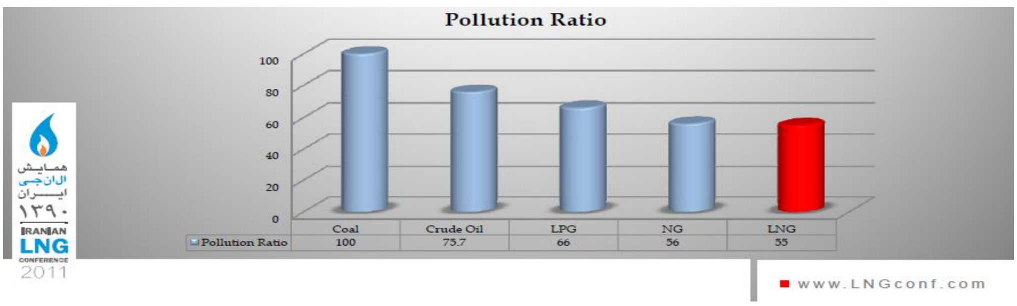
LNG is odourless, colourless, non–corrosive, and non–toxic. The liquefaction process requires the removal of some of the non–methane components, such as water and carbon dioxide, from the produced gas to prevent them from forming solids when the gas is cooled to about LNG temperature (–162 degrees Celsius). As a result, LNG is typically made up mostly of methane (table 20). It is, occasionally, confused with other concepts, such as Natural Gas Liquids (NGL) and Liquefied Petroleum Gas (LPG), as the wet gases; as well as, Compressed

Natural Gas (CNG), Gas–to–Liquids (GTL) and LNG, as the wet gases (Naturalgas.org). Moreover, the volume of natural gas is measured in a number of ways, e.g. cubic feet, tons, oil equivalents and cubic meters (annex 10).

NGL is made of molecules heavier than methane, so 95% of its compositions are ethane, propane, and butane with additional carbon atoms. LPG, furthermore, is a mixture of propane and butane in a liquid state and highly flammable. It has been used as fuel in light duty vehicles. LNG is not the same as CNG, while the latter has the same composition as piped gas and is mostly used as a fuel for vehicle transportation. LNG is also not synonymous with GTL, whereas the latter is a conversion of natural gas to other products, in particular methanol, according to the Centre for Energy Economics (CEE).

Besides the economic advantages of LNG, its stronger environmental friendliness relative to other energy carriers is a fact that makes this fuel one of the cleanest fossil fuels. Therefore, if we determine the emission index of greenhouse gases for coal as 100, this index is 75.5 for crude oil, 66 for LPG, 56 for natural gas and under 55 for LNG (figure 59).

Figure 59: Environmental pollution ratio for various fossil fuels



Source: Iran's LNG Conference, Tehran, October 2011

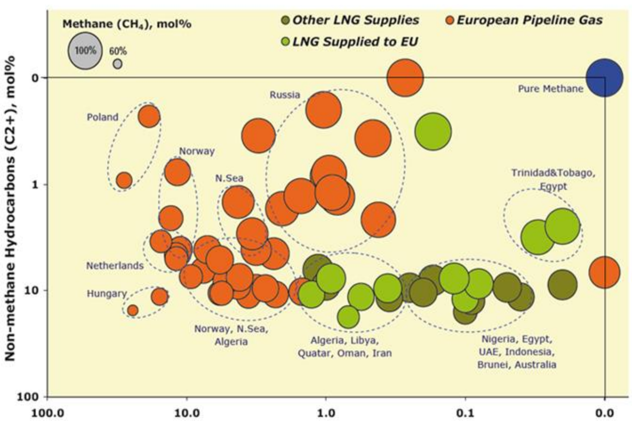
As a result of processing, LNG tends to contain slightly more of these higher hydrocarbons than piped gas. On the other hand, LNG has only minor amounts of nitrogen and no carbon dioxide (table 20). All in all, pipeline gas contains at least ten times the quantity of inerts or neutral gases. Summing up, LNG, as a logistics concept in Europe, might be considered as a superior quality fuel to pipeline gas (European Commission, Joint Research Centre, 2009: 14).

Figure 60 represents the differences in the chemical compositions, in terms of methane or less methane, of piped gas and LNG towards the EU from different actual and potential suppliers. The grouping of LNG suppliers in the bottom–right part of the graph is very prominent. Conversely, pipeline natural gases are concentrated on the left–hand side, indicating lower purity in comparison to pure methane (top–right corner). Altogether, these facts underpin the distinction between LNG and the pipeline gas.

The second aspect of acceptability or sustainability (Peimani, 2011:3; K. Sovacool, 2011: 9) is social dimension. The Official Journal of the EU (6th March 2012: 18) with reference to the "European Economic and Social Committee" meeting on 14th June, has proposed that "any energy pact within the Union should enshrine the strategic and vital nature of energy, including accessibility, affordability, reliability and regularity, so such a European social energy could respond to public concerns". It means that all the people within a community, even the poor, can afford getting access to more affordable energy with the best price. Alhajji believed (2007c) that higher energy prices widen the gap between the rich and the poor which can lead to political unrest and affect the economic growth of any country. Fatih Birol, IEA Chief Economist, even considers the "energy poverty", as a term against the energy security, in particular for the poor, and one of the three major strategic challenges that the global system will face in future (Birol, 2007: 1–6).

In conclusion, environmental risks (acceptability) at the heart of the "Climate–Energy" strategy (European

Figure 60: Composition of EU pipelines and LNG from suppliers



- The relative size of the bubbles indicates the methane content

Source: JRC, EC's Report EUR23818EN, 2009: 18

Commission, COM 2007: 1), require the urgent need for more acceptable, cleaner and reliable energy sources, according to the EU Energy Commissioner in 2010.

5.2.2. Availability of natural gas and LNG, two variables

Geographical distribution of energy reserves is important and might adversely influence security of supply, if these resources are found in only a few regions (Lako & Kets, 2005: 52). K. Sovacool (2011: 9 & 191) defined physical availability as when the consumers are able to secure the amount of natural gas that they need from gas–rich regions and countries.

The availability of fossil and fissile energy sources, such as nuclear energy sources, is described in terms of discovered and also undiscovered reserves with a probability of exploration in the future, the estimation of available deposits and in which areas, alongside the size of these fields.

The declining availability of hydrocarbons may cause increases in fuel prices and the sustainability of energy supply in future, while renewable energy sources may not be appropriately developed in time, perhaps until 2050 (or 2035, if applicable) (Lako and Kets, 2005: 13).

Most of the official predictions regarding the prospect of the global energy market focus on further dramatic changes toward natural gas in the future years and decades, so the share of this kind of hydrocarbon will increase more than in the past in the global energy mix. The majority of countries have to import natural gas and LNG for ensuring their energy needs (Proedrou, 2012) even from remote regions (G. Victor & H. Hayes, 2006: 319–357), such as the Arctic. According to the US' Geological Survey (USGS) in a 2000 assessment, approximately 25% of the undiscovered petroleum reserves are in the Arctic, especially in Russian Siberia, making this far–distance region's hydrocarbons an important economic and geopolitical issue. This issue has created some disputes amongst the Arctic's adjacent countries lying entirely south of the Arctic Circle, including Alaska/US, Canada, Norway, Russia, Greenland/Denmark (Mikkelsen & Langhelle, 2008: 2–6).

According to the European Commission, Joint Research Centre, Energy Security Unit (Costescu Badea, 2010: 4), the availability of natural gas defines the amount of global conventional and unconventional resources (geological feature) and the share of each country and region. So, the main question in this criteria of the energy security is "which countries or regions control the major natural gas reserves?" (annex 20).

Russia possesses close to one fourth of total gas reserves worldwide. Beyond Russia's predominant role on the global gas market in the future, Iran comes second in terms of world gas reserves, followed by Qatar. Other significant exporters are from the Persian Gulf, Central Asia, North Africa and then Asia–Oceania (table 21). So, three–quarters of global reserves are situated in the Middle East/Persian Gulf and the Former Soviet Union (FSU) countries, while nearly 40% of globally–proved gas reserves is situated in the Persian Gulf (table 21). The US is the only western well–developed economy which also has huge unconventional gas reserves.

Table 21: The world's top 15 proven natural gas holders, 2010–2012 (bcf)

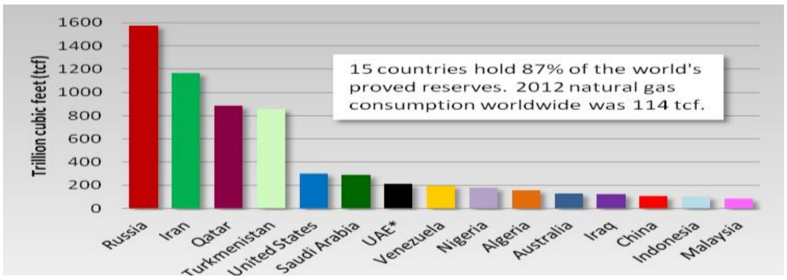
Rank	Country	1st Jan, 2010	1st Jan, 2011	Share in the world, 1st Jan, 2011	1st Jan, 2012	Share in the world, 1st Jan, 2012
1.	Russia	1,680,000	1,680,000	25.3%	1,680,000	24.9%
2.	Iran	1,045,670	1,045,670	15.7%	1,168,000	17.3%
3.	Qatar	899,325	895,800	13.5%	890,000	13.2%
4.	Saudi Arabia	263,000	275,200	4.1%	283,000	4.2%
5.	The US	244,656	244,656	3.7%	272,509	4.0%
6.	Turkmenistan	265,000	265,000	4.0%	265,000	3.9%
7.	The UAE	214,400	227,900	3.4%	215,035	3.2%
8.	Venezuela	175,970	178,860	2.7%	195,100	2.9%
9.	Nigeria	185,280	186,880	2.8%	180,458	2.7%
10.	Algeria	159,000	159,000	2.4%	159,000	2.4%
11.	Australia	110,000	110,000	1.7%	111.525	1.7%
12.	Iraq	111,940	111,940	1.7%	111,520	1.7%
13.	China	107,000	107,000	1.6%	107,000	1.6%
14.	Indonesia	106,000	106,000	1.6%	106,060	1.6%
15.	Malaysia	83,000	83,000	1.2%	83,000	1.2%
World total		6,609,346	6,647,341	87.4%	6,746,751	86.8%
Total OPEC		3,182,829	3,211,152	–	3,330,137	–

Source: OGJ Jan 1, 2012, USGS, EIA International Energy Outlook 2011: 64

So, the biggest increase in gas discovery at the start of 2012, compared to one year before that, has occurred in Iran, followed by the US and Saudi Arabia.

Oil and Gas Journal's annual look at worldwide gas reserves shows an increase to 6,746.8 tcf in 2012 from 6,647.3 tcf in the 2011 survey. Total gas reserves for OPEC are up nearly 4% from a year ago. Reported gas reserves climbed by 12% in Iran and declined in Libya by 3%. As of Jan. 1, 2012, OPEC's gas reserves totalled 3,330.1 tcf, or 49% of the world's resources.

Figure 61: The world's largest natural gas reserves



Source: BP Statistical Review of World Energy, 2012

According to BP, 2009 and the USGS, 2000, the current proved conventional gas in the world would be sufficient for nearly 70 years, based on, of course, on current demands, while the volume of unproved levels of conventional gas is twice the total amount of the existing, discovered natural gas reserves (Jaffe & Soligo, 2006: 437–468).

Clément Therme in an interview on 25th May 2012, argued that in the Persian Gulf, particularly Iran, there are significant natural gas reserves, which are not yet exploited and, on the basis of Peimani's interview (2012), "this country has a distinct potential to emerge as the first largest gas holder worldwide in the future, given its continued discovery of new gas fields". He added that the availability of the Persian Gulf's natural gas reserves, especially in "Iran and Qatar basins, having the world's 2ndand 3rd largest gas reserves are crucial for the EU's energy security", although discovery projects are underway in other areas, such as Libya and Iraq, and Australia, as well as small countries, e.g. Mozambique, according to Luciani in an interview on 7th March 2012.

According to OME's report (2012:10) Israel will, furthermore, join the Mediterranean gas exporters club with a modest contribution with the total potentiality for export from 80 bcm/y in 2010 to 140–190 bcm/y by 2030, after Algeria, Egypt and Libya. Based on this report and also the above–mentioned Oil and Gas Journal 2012, almost 5% of the world's hydrocarbon reserves are situated in the Mediterranean region. Algeria with 50.3% of regional NG reserves is the foremost, followed by Egypt (24.7%), Libya (16.7%), Israel (5.3%), and 3% of the rest are in other regional countries. So, Israel places in 45th position of global gas holders (annex 20).

Nonetheless, Simon Henderson, the Baker fellow and director of the Persian Gulf and Energy Policy Programme at the Washington Institute, in his latest essay on 7th 2012, has indicated some of the challenges that Israel encounters commercially, diplomatically, financially and geo–politically.

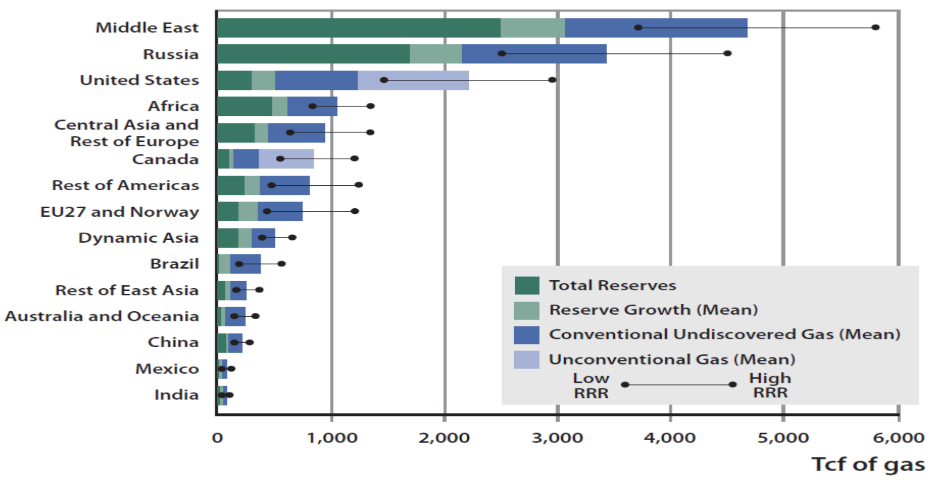
The world economy system is changing fundamentally with the newly–emerging economy giants in Asia, e.g. China and India, Latin America and other regions. At the same time, well–developed states and regions, such as the US, Japan and the EU are mature natural gas consumers, albeit that the global economic recession of 2007–8 seems to have put a hold on energy demand in the western world (Stern, 2009: 1), whereas China and India have dramatically increased their consumption. These main natural gas and LNG importers will compete more with each other for further access to adequate supplies to try and avoid the economic and social problems of energy shortages. As a result, natural gas will encounter a "big jump" by 2030, according to Prof. Geoffrey Kemp (annex 1) in the "Asianisation of the Middle East" at Durham University on 13th September 2012.

The EU will be the world's largest gas importer by 2030 (figure 70) (European Commissionworking Paper, 2011: 2; BP 2012, Energy Outlook 2030: 76) and meeting this growing demand clearly involves more natural gas discovery or access to the economical gas fields to increase volumes of natural gas and LNG imports (R. Odell, 2002: 439).

Luciani (interview, 2012) raised one more point, that the supply of gas, notably LNG, is expected to be abundant. "This is the consequence of the turnaround in the US supply situation (the US is on the way to become a net exporter of LNG) which displaced the large increase of capacity in Qatar and Australia". Thanks to the Fukushima accident, the displaced gas found a market in the Far East, but it is not clear that this can be projected into the future. However, it could be added to his argument that while unconventional gas will develop in North America and the amount of LNG exports toward the US could divert to other areas, global natural gas and LNG demands will increase dramatically.

As explained in chapter 4, unconventional gas reserves are abundant and sporadic in different regions and countries respectively, but face some financial, environmental and other challenges. So, according to the US EIA International Energy Outlook (2011: 50) it will cover around 18% of global production by 2030 (figure 62) most of which is to be consumed in the US, while the whole of Europe will hold 9% of the world's unconventional gas production by then, equivalent to nearly 1.5% of global gas production.

Figure 62: The global proved and unproved conventional and unconventional gases

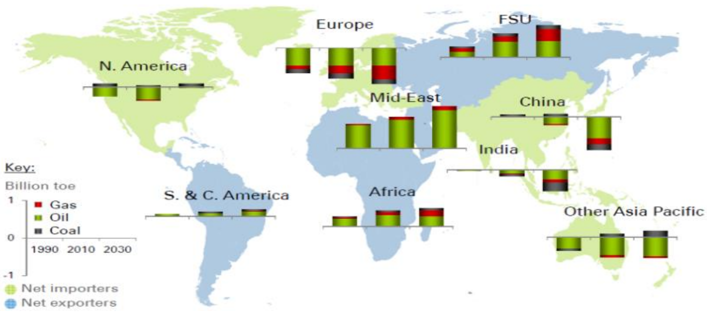


Source: MIT multidisciplinary report, "The Future of Natural Gas", the US, 2012: 23

According to the BIWGTM, regarding the role of natural gas, LNG, unconventional gas in the future, while the production of gas from coal started in 1792 commercially and the first company, the so–called Baltimore, in this regard was established in the US in 1816, but before 2020 these kinds of unconventional gas industries could not compete with conventional gas with less than $5 in mbtu. Moreover, in 2030, high–tech unconventional gas could replace conventional gas by around 18% (figure 43 & annex 7) with the base price of $5.50 in mbtu and finally in 2100 the replacement technologies could most likely give up the natural gas completely with the $5.50 in mbtu (Hartley & Medlock, 2006: 357–407).

With the continuing decrease or depletion of fields in the UK and the Netherlands, Norway will thus become the single most important supplier within the borders of Europe in the future (Lochner & Bothe, 2009: 1526) (see Chapter 2).Müller Kraenner (2008: 17) believed that this era faces the crisis with declining availability of fossil fuels, in particular natural gas, on the one hand and the restricted ability to contain the environmental pollution, on the other.

Figure 63: The global fossil demands, 1990–2030



Source: BP 2012, Energy Outlook 2030: 76

According to an interview with Thierry Coville (2012) on 18th April 2012, increased natural gas and LNG supply toward the EU will ensure its energy security and, apart from political issues, more imports from the gas–rich countries and regions could ensure the security of the gas supply of the Union.

Prof. Pirouz Mojtahed Zadeh (annex1), in an interview on 17th May 2012, confirmed Thierry's argument and added that the availability of gas reserves in some gas–rich countries, such as Iran and Qatar with nearly one–third of global gas deposits and the actual and potential LNG suppliers toward the EU, Asia, and the other importers, will ensure their energy security because of the huge availability of gas.

On the other hand, Yergin (2006: 75), believed that the major obstacle(s) to the development of the existing and potential deposits is not geological, but political, geo–political, financial and technological. Although, the availability of natural gas supply is important, "natural gas and LNG importers are concerned not just with the availability of this hydrocarbon but also security of supply, production, uninterrupted transportation and timely distribution inside their region and countries with affordable prices" (Peimani, 2011: 2&3).

In conclusion, in such a world with its growing gas demands outlook, the main crucial gas players are, geo–politically, the ones holding the large amounts of natural gas reserves and also enjoying strong management to prepare suitable situations for attracting the required investment and confidence (G. Victor & H. Hayes, 2006: 319–357), that is shown by the fact that Trinidad and Tobago has turned in to the major LNG exporter to the US, whereas Venezuela, with huge gas reserves and a shorter distance to the US has been marginalised (M. Jaffe & Soligo, 2006: 437–468).

To sum up, the best gas reserves are those with easy access and huge shallow off–shore ones but also close to the coastline with enough liquefaction facilities and also near to gas markets. As a result, these gas suppliers should be either so close to gas consumers that pipelines become economical or so far from the importers' markets that LNG would be reasonable and affordable and that will be dealt with them in the next section (G. Victor & H. Hayes, 2006: 319–357).

5.2.3. Affordability of natural gas and LNG towards the EU, three variables

Economic affordability (Sovacool, 2011: 191), as one of the main four energy security indicators "involves not only low or equitable prices relative to income, but also stable prices that are non–volatile" (Sovacool, 2011: 9); that is a shared concern for both producers and consumers (Pascual & Zambetakis, 2010: 12).

The Energy Security Unit, Joint Research Centre for theEuropean Commission, (Costescu Badea, 2010: 4) defines affordability when, “the consumers are able to afford energy services, capital and operating cost structures for developing various energy sources” in order to achieve more reasonable natural gas and LNG prices.

As mentioned earlier, Fatih Birol (Birol, 2007) called energy poverty one of the triple challenges in the world and emphasised the essential role of affordable energy in economic growth and human development.

5.2.3.1. Natural gas and LNG pricing mechanisms

Unlike with crude oil, natural gas does not have a global market or price, but is regional, hence some additional natural gas and LNG players may have a need for a globalised and liberalised gas market in the future (Cherp & Goldthau, 2011) and by increasing LNG trading and with more flexibility in its markets, gas markets could witness more integrated pricing (Barnes, et al. 2006: 3–27), reduction of risks, diversifying of suppliers and more security of supply (Jaffe & Soligo, 2006: 437–468).

The establishment of any coherent global gas market will be probably practical, while any event in one country or region affects directly on other regions (Jaffe & Soligo, 2006: 437–468).

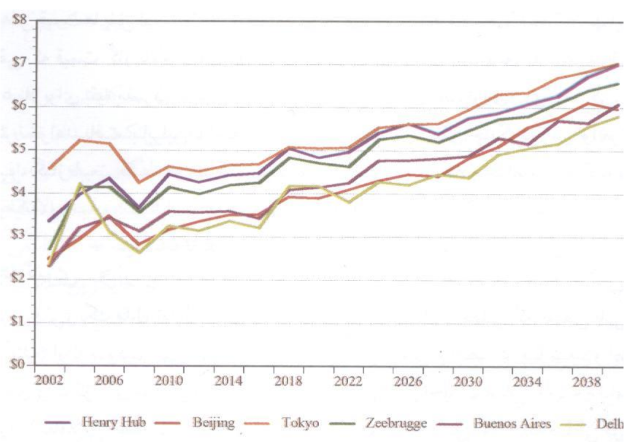
“Improved LNG systems would increase competition with the new suppliers being able to enter the market and this could lead to reducing the price of natural gas reasonably, as the low cost natural gas and LNG can only lead to waste”, on the basis of Clément Therme’s comments (interview, 2012). This is because Howard Rogers (interview, 2012) predicted that in the future LNG global markets, different suppliers will send their products to various regions. He took Australian’s LNG as an example that might replace some Qatari LNG supply into the Atlantic basin and also more LNG producers within the Persian Gulf, sending their products to the east, south Asian and European markets. As explained in chapter 4, any creation of Gas–OPEC and the stronger GEFC, with 90% of the world’s LNG exports, could challenge these gas markets in the future and lead to more coordinated actions in order to increase the price (RIA Novosti, 12nd February 2007).

Until then, the natural gas prices are negotiated locally and quite often are not made public and this lack of transparency provides for more opportunities for securitisation. In the North American market, moreover, gas is traded at the New York Mercantile Exchange (NYMEX) hub in accordance with supply and demand forces (Proedrou, 2012), like the Atlantic LNG project in Trinidad and Tobago (G. Victor & H. Hayes, 2006: 319–357), but in the European continent, gas prices have followed oil–linked price formulas, based on three–quarters of the price of one basket of crude oil (M. Victor & G. Victor, 2006: 122–169) and other considerations, such as transportation costs, add up to the final price (Proedrou, 2012). In the East Asia and Japanese markets, natural gas and LNG are calculated on the basis of JCC (G. Victor & H. Hayes, 2006: 319–357).

With regard to gas pricing, there are some pricing mechanisms in different regional gas markets. Clément Therme (2012) also believed that “energy model of free market with fluctuating prices is the favoured option for LNG exports (Qatari’s model) and a state model, based on the administered price of exports through gas pipelines is another choice (Russian model)”.

Albeit, some argued that if the oil price remains high, an independent gas pricing mechanism will be developed in Europe (Proedrou, 2012; Stern, 2009: 15–16) and excess gas supply relative to demand, coupled with the seller’s motivation to sell more natural gas and LNG, could possibly lead to making gas prices more independent of oil (R. Odell, 2002: 448).

Figure 64: Outlook of gas price in various hubs, 2002–2038



Source: Hartley & B. Medlock, 2006: 357–407

Figure 64 shows the American Henry Hub and the European Zeebrugge are the main sources for gas prices worldwide and the role of some other regional resources would be increased, such as Tokyo, Beijing and Delhi in Asia, as well as Buenos Aires in South America. This figure, moreover, illustrates that the price in the mentioned sources will become closer to each other and integrate more, thanks to the growing role of LNG in the future's global gas market, such as Japan's situation right now and globalisation of the natural gas and LNG price in the future, like oil (Hartley & B. Medlock, 2006: 357–407).

If energy prices are high, it could lead to escalate the energy efficiency and thus reduce pollution, according to Alhajji (2007d), therefore the price does determine the extent and the kind of energy use (Proedrou, 2012).

Supply costs are the cost of delivering natural gas and LNG to the relevant country or region, including production and transportation costs (Lochner & Bothe, 2009: 1523).

5.2.3.2. LNG production costs in different suppliers

Investment in production facilities, which make up more than 90% of total supply costs, depends on field size and depth, on–shore or off–shore location, associated or non–associated gas, environmental conditions, availability of infrastructure and also a skilled workforce (OME, 2001: 3). It is particularly field size and geographic location that have the largest impacts on per–unit extraction costs (Lochner & Bothe, 2009: 1521). The Joint Venture Agreement (JVA) and Production Sharing Agreement (PSA) are two kinds of investment in both gas production and its upstream industries (M. Victor & G. Victor, 2006: 122–169).

The depth and the size of gas reserves are the two main important factors for measuring the rate of investments, according to the USGS (Hartley & Medlock, 2006: 357–407). So, the gas production costs could vary from one country or region to another one, while the lowest production costs belong to the large non–associate on–shore gas fields, the production from the smaller off–shore fields in deeper waters are the most expensive (Lochner & Bothe, 2009: 1521). According to table 22, the largest non–associated gas fields in the world, more than 50%, are situated in Iran and Qatar, particularly the former country. As a result, the lowest production costs in gas reserves in the world, apply to these two gas holders (table 23). Howard Rogers (interview, 2012) argued that “given the relatively shallow water location of the Iranian South Pars and Qatari North Field and the co–production of condensate, such LNG projects would have a lower cost base than future Australian LNG projects (which would be a main competing source of new LNG), so many International Oil Companies’ have long hoped to be able to access natural gas and LNG development opportunities in these attractive on–shore and off–shore areas”.

Table 22: Largest non–associated gas fields in the world (in tcf)

№	Field name	Country	Recoverable reserves[1]
1	South Pars/North Dome	Iran and Qatar	1,235 × 10^{12} cu ft (35,000 km^3)
2	Urengoy	Russia	222 × 10^{12} cu ft (6,300 km^3)
3	Yamburg	Russia	138 × 10^{12} cu ft (3,900 km^3)
4	Hassi R'Mel	Algeria	123 × 10^{12} cu ft (3,500 km^3)
5	Shtokman	Russia	110 × 10^{12} cu ft (3,100 km^3)
6	South Iolotan–Osman	Turkmenistan	98 × 10^{12} cu ft (2,800 km^3)
7	Zapolyarnoye	Russia	95 × 10^{12} cu ft (2,700 km^3)
8	Hugoton	USA (TX-OK-KS)	81 × 10^{12} cu ft (2,300 km^3)
9	Groningen	Netherlands	73 × 10^{12} cu ft (2,100 km^3)
10	Bovanenko	Russia	70 × 10^{12} cu ft (2,000 km^3)
11	Medvezhye	Russia	68 × 10^{12} cu ft (1,900 km^3)
12	North Pars	Iran	48 × 10^{12} cu ft (1,400 km^3)
13	Dauletabad-Donmez	Turkmenistan	47 × 10^{12} cu ft (1,300 km^3)
14	Karachaganak	Kazakhstan	46 × 10^{12} cu ft (1,300 km^3)
15	Kish	Iran	45 × 10^{12} cu ft (1,300 km^3)
16	Orenburg	Russia	45 × 10^{12} cu ft (1,300 km^3)
17	Kharsavey	Russia	42 × 10^{12} cu ft (1,200 km^3)
18	Shah Deniz	Azerbaijan	42 × 10^{12} cu ft (1,200 km^3)
19	Golshan	Iran	30 × 10^{12} cu ft (850 km^3)
20	Tabnak	Iran	22 × 10^{12} cu ft (620 km^3)
21	Kangan	Iran	20 × 10^{12} cu ft (570 km^3)

Source: http://en.wikipedia.org/wiki/List_of_natural_gas_fields

IEA (2003) in its World Energy Investment Outlook, estimated that more than half of the investments should be allocated to discover and develop the gas fields (production stage), while the most risk in the investment process might be in excavation, exploration and exploitation parts (Hartley & Medlock, 2006: 407–439), so any undeveloped region with huge and least expensive gas reserves, such as in the Persian Gulf, could lead to a fall of at least 50% of production cost.

Some believe that in the case of a fall in the price of natural gas and LNG, the venture will not be economical in high–cost regions, so low–cost gas reserves seem more suitable for investment (R. Odell, 2002: 432). For instance, some of the Russian gas fields have relatively low production costs, contrary to the gas fields situated in some other areas, such as in the Barents Sea which are more difficult to access and therefore more expensive to exploit. The US and Norway (due to new investments in the exploration and exploitation of the expensive fields) enjoy the same situations as in Russia n gas fields and the production costs in other regions, comprising Africa, Asia/Oceania and Latin America are not more than $1 in mbtu (table 23). So, a number of the known EU's indigenous gas reserves are not profitable to produce (R. Odell, 2002: 441).

Howard Rogers (interview, 2012) also believed that investment within the Persian Gulf's gas reserves is the cheapest, so the price of the final natural gas and LNG supply might be more suitable for the EU, "while any engagement with the EU member states in LNG trade would hopefully engender a more open and progressive stance on the part of the Union's counterparts towards economic and political engagement with Europe".

Table 23: Range of production costs for gas producing regions until 2030 (in $/MBtu)

country	production costs	
	Lowest	Highest
Algeria	0.40	0.80
Australia	0.60	1.00
Canada	0.70	1.20
Indonesia	0.50	1.00
Iran	0.35	0.70
Netherlands	0.20	1.40
Nigeria	0.60	1.20
Norway (North Sea)	0.80	1.40
Norway (Barents Sea)	1.20	1.70
Qatar	0.35	0.60
Russia (Western Siberia)	0.40	1.20
Russia (Barents Sea)	1.00	1.30
Russia (Sakhanlin)	0.80	1.30
United Kingdom	1.20	1.60
United States	0.70	1.70
Venezuela	0.60	1.00

Source: Lochner, Stefan & Bothe, David (2009), Energy Policy 37: 1521

The relative regional shares of global gas production for selected years are presented in table 24. According to this table, in addition to annexes 7 and 16, the most growth in gas production up to 2030 will take place in the Middle East/Persian Gulf. As a result, this region and particularly Iran and Qatar will become to the third biggest gas producers and the second largest exporters in the world (table 24 & figure 72).

Table 24: The percentage of gas producing regions worldwide, 2000–2030

Region	2010 (BP, 2011)	2020(EIA, 2011)	2030 (EIA, 2011)
Africa	7.0%	8.3%	8.4%
Asia/ Oceania	15.5%	15.3%	17.1%
Europe	8.7%	5.6%	5.0%
FUS/CIS	23.9% (Russia: 18.4%)	24.4% (Russia: 18.6%)	24.2% (Russia: 18.7%)
Latin America	5.1%	4.9%	5.3%
ME/PG	13.7% (Iran & Qatar: 7.7%)	16.7 % (Iran & Qatar: 10.5%)	17.8 % (Iran & Qatar: 11.1%)
North America	26.1% (the US: 19.3%)	24.6% (the US: 17.5%)	22.2% (the US: 15.9%)

Source: By Author, based on: BP Statistical Review of World Energy, June 2011 (annex 6); EIA International Energy Outlook 2011: 50 (annex 7); Lochner, Stefan & Bothe, David (2009), Energy Policy 37: 1523.

5.2.3.3. LNG transportation costs from different suppliers to the EU

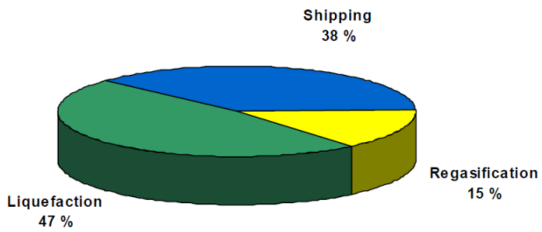
The second phase of supply cost is related to transportation. Shipping LNG by sea is the only viable way to transport the natural gas over distances (Palm, 2007: 15) and this includes three stages, comprising the liquefaction of gas, its maritime transport and the regasification at the destination (Lochner & Bothe, 2009: 1522). The liquefaction process is done in what are called trains when the natural gas is cooled to approximately –162°C and between 5 and 15% of the gas is used in the plant during the cooling process. First of all, water and other substances are removed from wet gas and then gas is cooled to –35°C to separate the heavier hydrogen atoms from the methane. This step is not done for pipeline gas, making LNG cleaner with higher methane content than pipeline gas, odourless, clear, and non–toxic liquid (BP, 2006). Finally, the gas is cooled to –162°C and turned into LNG with 600 times more compression than in gas form. There are two main technologies used in liquefaction today, namely Air Products (APCI) and the Phillips cascade technology (Palm, 2007: 16).

In the regasification plant, the liquid gas is heated and converts in to the gas again with a number of technologies, encompassing direct–fired heaters and heating by passing the gas through pipes submerged in seawater or heated water. This process requires energy as well, but significantly less than for liquefaction. Large compressors are used to pump the gas into the pipelines. Moreover, the plant contains storage facilities with tanks, being important to store the LNG to distribute the gas to the consumers, cover peak demand and/or minor disruptions in deliveries (Palm, 2007: 18).

5.2.3.4. LNG liquefaction costs in different suppliers

For liquefaction terminals and regasification plants, investment costs are assumed to be $265 million and $100 million (in 2005 terms) for 1bcm/y liquefaction and regasification capacity, respectively. So,the LNG receiving facilities are relatively cheaper and cost only between one–third and two–fifths of the average liquefaction terminals and 15% of the total of the LNG chain costs (Lochner & Bothe, 2009: 1522), while the main cost is in the liquefaction process with close to half of the LNG transportation chain cost (Palm, 2007: 12) (figure 65).

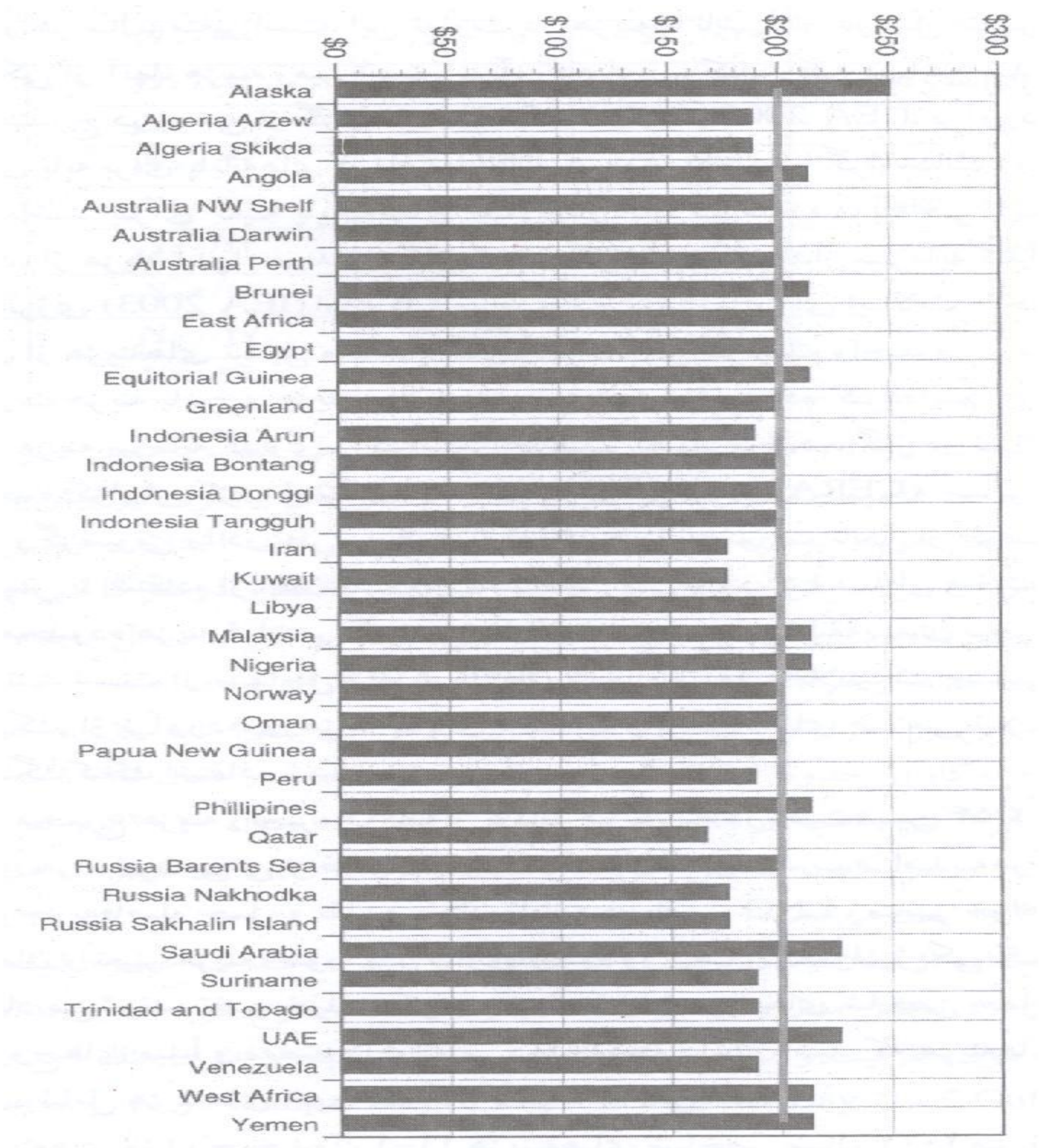
Figure 65: The stages of LNG transportation chain in percentage



Source: Fredrik Palm, 2007: 20

According to WEIO (World Energy Investment Outlook) published by the IEA in 2003, the cost of liquefaction investment in gas holders varies from one country to another one. This international energy organization compared this cost in 37 minor and major gas holders and found that Qatar, Iran, Kuwait, Russian Nakhodka, as well as Russian Sakhalin Island benefit from the cheapest liquefaction costs worldwide (figure 66).

Figure 66: The required investment for liquefaction by country ($ in 1000 m^3)



Source: Hartley and Medlock, 2006: 357–407

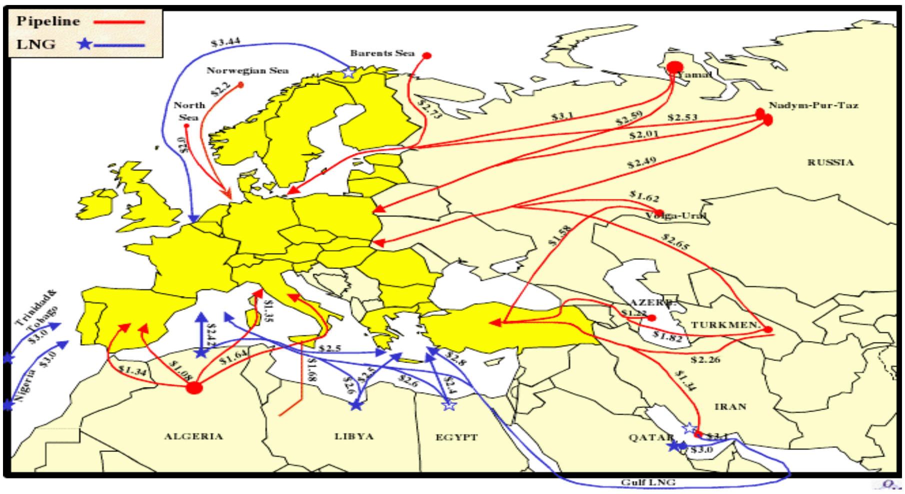
5.2.3.5. LNG shipping costs from different suppliers

Shipping costs, as the second stage in transportation value chain, consist of the LNG vessels' capital and voyage costs, while the price of a LNG vessel since 2005 has been nearly halved, compared to one decade before that date, and also larger vessels have been constructed, all causing a reduction in LNG costs (Palm, 2007: 21). In addition, increasing distances, more than 3500–4000 km, favours the LNG technology as a means of more economical transport (Lochner & Bothe, 2009: 1518).

Since the 1990s, the LNG industry has been developing fundamentally technologically and commercially, leading to at least one–third of reduction in the transportation costs to consumers (Barnes et al. 2006: 3–27).

In the Magellan gas model, as a long–term gas supply and interregional cost–minimisation model up to 2035, raised by this corporation in the US, an average investment in LNG supply has declined by 1.5% per annum, since 2005, due to the technological progress, and these processes will impact on the average supply costs of LNG volumes and transportation during the next 20 years and beyond (Lochner & Bothe, 2009: 1522). OME's calculations regarding the cost of pipeline and LNG transportations from various actual and potential suppliers towards the EU (map 11) are very close to Magellan's model.

Map 11: Transportation cost for new NG/LNG delivery to EU, 2010–2020, ($/MBtu)

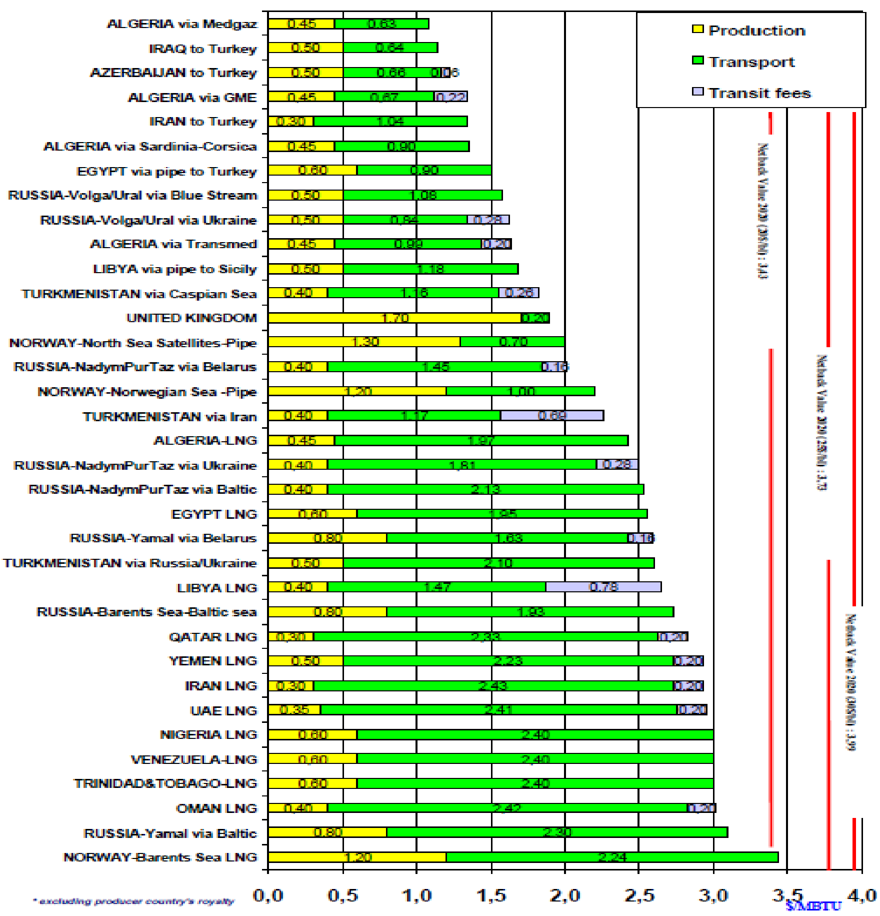


Source: OME, "Future NG/LNG Supply Options and Cost for the EU": 27

According to figure 67, the range of lowest and highest LNG transportation costs from various global suppliers, excluding Asia–Pacific to the EU are situated between $1.47 in 1 MBtu in Libya to $2.43 in 1 MBtu in Iran. However, the gas supplied at the highest cost to the EU is projected to be LNG from Norway–Barents Sea, Oman, Trinidad and Tobago, Venezuela, Nigeria, Yemen and the United Arab Emirates, while the cheapest belongs to Algeria, Egypt and Libya, followed by Qatar and Iran. The above–mentioned table 23 that shows the cost–to–production of some other suppliers from Asia–Pacific by 2030 could complete the figure 67.

Peimani (interview, 2012) argued that the close proximity of the Persian Gulf to Europe, in addition to the cheapest cost of production, is another factor to decrease the cost of LNG imports for the EU, having been in search of less expensive fuels for obvious reasons, including improving its competiveness and helping its members towards economic recovery after a long period of recession.

Figure 67: Production and transportation pipeline and LNG costs towards the EU, 2010–2020 ($ in MBtu)

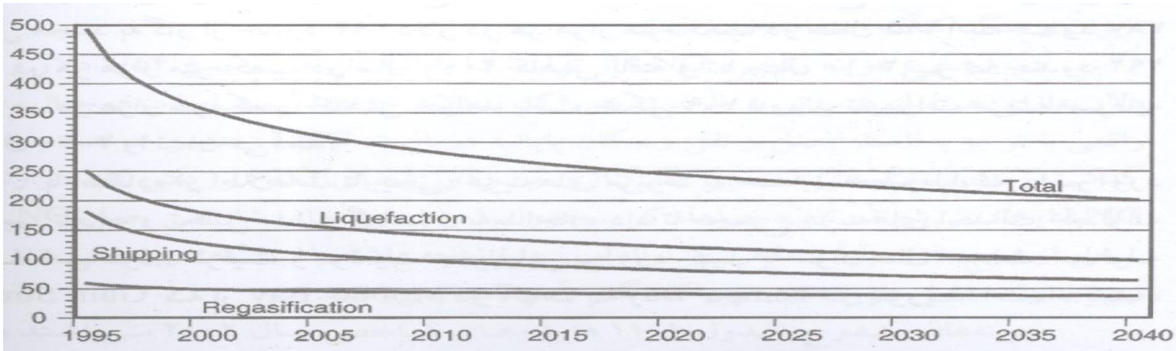


Source: OME, "Future gas Supply Options and Cost for the EU": 10

On the other hand, Korin (interview, 2012) pointed to another issue, apart from upstream and downstream costs. He referred to the globalised oil market conditions that "Saudi Arabian oil cost while lifting is $2 a barrel, but the spot price is around $100 in global markets". So, he concluded that whereas the Persian Gulf's gas reserves are very significant and the cost to producers is low, it is unclear if the price to the consumers will be the same and some other factors, such as political tensions will impact on the globalised gas market in the future similar what has happened with oil.

As a whole, IEA (2003) in its World Energy Investment Outlook predicted that investments in LNG industries will double by 2020. According to this report, the total cost of liquefaction, transportation and also regasification has decreased from $494 in 1000 cm in 1995 to $387 and $292 in the same volume in 2000 and by 2010 respectively. According to its forecast, it could also reach nearly $200 before 2040 (figure 68).

Figure 68: The essential investment in LNG industry, 1995–2040 ($ in 1000 m^3)



Source: Hartley and B. Medlock, 2006: 357–407

5.2.3.6. Regasification in LNG buyers

On–board regasification is an economical new technology involving transforming the LNG into the gas on the ship and then pumping directly into the pipeline network, removing the need for on–shore regasification facilities. Furthermore, there are plans for floating off–shore regasification terminals, being able to transfer pressurised gas directly into the grid system (Palm, 2007: 18).

LNG buyers import this product in the framework of Cost, Insurance and Freight (C.I.F), comprising the price of LNG (partially in F.O.B[7]), the cost of transportation, as well as insurance (Barnes et al. 2006: 3–27) under long–term take–or–pay and also short–term spot contracts. Long–term contracts could help secure supplies, solidify the producer–consumer relation, and enable more ventures in new natural gas and LNG industries (Aad Correlje´, 2006: 540–542). However, Clément Therme (interview, 2012) argued that this kind of contract "makes more complex definition of an acceptable price (fixed price)", and will likely lead to more spot contracts with more reduced prices, competitive markets and even arbitrage within the EU, too.

However, in spite of the increasing importance of short–term contractual agreements, long–term supply contracts will remain the backbone of the European gas supplies that enjoy more gas net–backs (net profit after reducing of the transportation cost) in LNG compared to the US (Jaffe & Soligo, 2006: 437–468).

5.2.3.7. Natural gas and LNG price is a major concern in the EU

During the history of the European natural gas and LNG industries since around 1960, to date, the supply costs have mattered (R. Odell, 2002: 431), because of "the inevitability of higher prices" (R. Odell, 2002: 444). Ledesma and Hulbert (interview, 2012) rejected any cheap natural gas and LNG in the future, while the EU will make efforts to buy its required natural gas and LNG at a market price in competition with other thirsty importers in the "Great Game of the 21st century" (Sascha Muller–Kraenner, 2007). Oettinger, the EU Commissioner for Energy, discussed (2010: 2–5) the role of the new economic tigers in competition to achieve a larger share of the world's energy resources, particularly natural gas, which might lead to long–term price increases. So, the new dimension of geo–politics of energy security is competition amongst main global consumers (Pascual & Elkind, 2010: 3).

[7] Freight On Board: when the gas is sold simultaneous with moving from the liquefaction plant to the ship (Palm, 2007: 17).

Hulbert (annex 1) in an interview on 15th May 2012, referred to the point mentioned previously that if the globalised gas market will not be created and the market will not assign the price, so based on the current situation, "it is plausible that we will witness more LNG shifting from the Middle East/Persian Gulf to Asian markets in future, as the LNG net–back in Asia is around twice that of north–western Europe". This point is similar to Sund's opinion (interview, 2012) that the prospect of more LNG supply toward different markets, mostly Asia and Europe, will depend on prices there.

The economic risks (affordability), such as energy price fluctuations due to imbalances between supply and demand, inadequate investments in energy industries (e.g. renewable energy sources and natural gas and LNG infrastructures), and financial crises, are the other issues that the EU energy commissioner has dealt with. He argued that insufficient investment leads to reduction in EU energy competitiveness. Based on Oettinger' comments in Bahraini Capital, Manama, 2010, investment of around €1 trillion will be needed by 2020 by national and regional investors or sponsors, such as the European Investment Bank (EIB) to create new supply routes, infrastructures and even modernising them, energy storage, second generation biofuels and smart grids in the EU that Checchi and his colleagues described as the "facility risk" (Checchi et al. 2009: 43). So, the European Commission noted that "the main risk with regard to the Union's energy is economic, followed by the physical risks of disruption of supply" (European Commission, COM (2002) 488: 8).

The IEA projects that more than 50% of all interregional gas trading will be by LNG carriers by 2030 owing to expansion of LNG capacities, further progress in its technology (IEA, WEO 2004: 141) less geo–political complexity and cost of operation, than pipeline plans (Shepherd & James, 2006: 268–319), so this more globalised gas market alongside more competition could lead to affordable prices (Lochner & Bothe, 2009: 1518).

Karen Sund (interview, 2012), regarding the affordability of natural gas and LNG price within the EU, has raised two scenarios; that in a scenario with low prices in Europe, the producers will prefer other markets. In a scenario with high prices in Europe, more supplies (also unconventional gas) should be available to decrease importing from the Persian Gulf. She added that if the Persian Gulf states, mainly Iran and Qatar, choose to send more low–cost gas into a low–priced Europe, the price will fall further, which is not in their long–term interest. It is assumed that some of the investors will be international companies wanting maximum returns, thus aiming for Asia when possible, and higher prices in this continent might lead to more LNG supply and at shortage of this product in the EU, so this process could increase the price in Europe, as LNG has not been globalised yet.

Although, the low–cost–to–production LNG suppliers to Europe are Oman, Iran and Qatar (R. Odell, 2002: 451), and although the marginal Iranian gas volumes will be supplied by pipeline at a slightly higher cost “Qatar is in no hurry to further increase exports to the EU, unless the LNG price will rise, and may indeed have contrary interests given the current moratorium which is unlikely to be lifted before 2015”, according to Laura Elkatiri (interview, 2012).

Bahgat (interview, 2012) believes that, “Qatar has frozen any new gas deals and has sought to assess its production and export policies, so there is no way to predict the outcome of this assessment.”

Other alternatives would be from Central Asia’s gas suppliers, such as Turkmenistan and Uzbekistan, being potentially seen as additional gas competitors. However, some geo–political and economic situations of these potential gas suppliers to the EU should be considered, such as the required investment in gas industries, sufficient or insufficient political will, access to the most modern technologies, Russian control over some of these states’ gas policies, particularly Turkmenistan (R. Odell, 2002: 450–451).

Bahgat (interview, 2012) argued that Russian control on most of the Caspian Sea littoral states’ reserves continued shortly after the collapse of the USSR. However, the Caspian States have grown more independent from Moscow since the early 1990s, such as the Republic of Azerbaijan.

So, the EU's geographic proximity to the main LNG exporters helps it to diversify suppliers that could lead to moderate prices to the Union (Lochner & Bothe, 2009: 1527), providing massive investment in production and transportation capacities (Palm, 2007: 38) in more affordable regional or ultra–regional gas reserves. So, more investment only in low–risk/high–cost natural gas and LNG suppliers could not ensure future global demand with reasonable prices (Hartley & Medlock, 2006: 407–439). That will be discussed further in the next section in greater detail.

5.2.4. Accessibility/Feasibility/Reliability of natural gas and LNG, three variables

Ensuring sufficient natural gas and LNG supply with sustainability of access to resources (Proedrou, 2012), economic feasibility of social energy (GEA 2012: 22; K. Sovacool, 2011: 337) alongside reliability of this supply by different means, such as diversification of exporters (K. Sovacool, 2011: 9; Checchi et al. 2009: 43), are the main criteria of accessibility, as the fourth indicator of energy security, so the main question is, "how difficult is energy to get?"

The Energy Security Unit, Joint Research Centrefor the European Commission, (Costescu Badea, 2010: 4)argued that major infrastructures and technologies require to explore and develop available resources for natural gas and LNG trading. However, the geo–political (unstable regions, sanctions and embargo, sabotage and terrorism), financial (recession, lack of investment, etc.) and human constraints are counted as the main threatening factors against security of supply in both the short–and long–term.

Contrary to the previous energy security indicators, accessibility and its elements are more qualitative and difficult to be measured.

H. Hayes and G. Victor (2006: 3–49), the two natural gas and LNG experts, on the basis of primary data issued by international energy organizations, such as IEA, analysed the natural gas and LNG inter–regional trading outlook in the future. They have taken into consideration investment risks in different suppliers and transit countries in piped gas to quantify financial and geo–

political elements. The importance of investments in different parts of LNG industries was analysed in the affordability section, in greater detail. Moreover, a number of checkpoints in LNG routes have been replaced in pipelines in transit countries. Furthermore, the rate of any risk in consumers, such as economic downturn or higher investment risks, as well as the percentage of gas and LNG in these main EU importers' total primary energy sourcesis added to the mentioned indexes.

5.2.4.1. International Country Risk Guide/Composite Political, Financial, Economic Risk Rating in LNG suppliers

The first variable is general risk investment, depending on the internal situations in gas holders, with a couple of elements on the basis of the International Country Risk Guide (ICRG), being published on PRS Group Inc. monthly in New York, the US, that use Composite Political, Financial, Economic Risk Rating (CPFER) for each country and also The MEES (The Middle East Economic Survey) newsletter published by the MEPEP (The Middle East Petroleum and Economic Publications Ltd.) in Cyprus and Lebanon.

The ICRG rating comprises 22 variables, including 100 indicators, in three subcategories of risk: political, financial, and economic. The composite scores, ranging from zero to 100, are then broken into categories from Very Low Risk (80 to 100 points) to Very High Risk (zero to 49.5 points), so the higher the points, the lower the risk (annex 18).

On the basis of the PRS Group's monthly on 7th September, 2012, Norway, with 90.7 out of 100, is at the top of the global list for very low risk investment, while Oman and the United Arab Emirates are situated in 7th and 10th position in this ranking respectively. On the other hand, Somalia with 41.2 points is the worst country worldwide with very high risk investment and none of the main gas holders in the table below has under 57 points.

The governmental stability on the basis of regular elections is the main supporter of private or public investor entities and neutrality in the executing of law in the new global gas market, while the state of investment, including operation risks, tax system, the government's guarantee that the profit of private or other states' venture capital should be transferred to the investor's country (G. Victor & H. Hayes, 2006: 319–357) and the rate of the workforce's salary (Hartley & Medlock, 2006: 407–439) are the main criteria in political economic risks.

The least risk, furthermore, is attached to the countries without any armed opponents and also where governments do not treat with their citizens violently. The highest risk is, however, for the states with domestic war and the middle score is for the countries where kidnapping and terrorist actions are likely to happen (Hartley & Medlock, 2006: 407–439).

The second variable is the number of checkpoints in LNG routes, so when there is no any checkpoint in a particular sea lane, nil will be considered and with one transit state, number one and then the rating will go up, correspondingly.

The third variable is geo–political relations. Some elements take effect on this variable, like political and technological risks (the rate of liquefaction and regasification facilities that is explained in the accessibility section in further detail), depth of gas reserves on the seabed (H. Hayes, 2006: 49–91), regional tensions, less confidence from investors (Jaffe & Soligo, 2006: 437–468), etc.

As it is less likely to find any quantity indicators for geo–political affiliations, so H. Hayes and G. Victor paid more attention to a range of international organizations, mostly economic and commercial ones in chapter 2 of their co–authored book and ranked them on the basis of the rate of the organization's power on its members and also institutional cooperation, implementation of commitments and functions, as well as any historical experience in previous natural gas and LNG projects in that organization. Then, these organizations are scored at between nil to five, based on the above criteria. For example, they believe EFTA and NAFTA get 5 points, MERCOSUR gains a score3, while 2 points is sufficient for OAS and GCC.

Although this argument is true that any coherent and strong regional organization and institute could have an effect on its members and help more security of supply by regional cooperation, however the quantification of the organization's power is not perfect, while some of the main gas suppliers are the members of top organizations and institutions, but they sometimes fail in fulfilling their commitments, such as what happened in gas disruption since 2006 against Europe by Russia. Venezuela, moreover, is a member of notable organizations, however the risk of investment in this country is high (table 25).

Another criteria returns to the natural gas and LNG consumer's risk, being created by these countries' energy policy and the rate of natural gas share in their energy mix. It means the more the rate of gas share in any importer rises, the more risks in this country will arise.

Nevertheless, one more criterion could be added to the main natural gas and LNG importers within the EU, therefore under current economic circumstances in the Union, particularly in the Eurozone, the economic risks index in these countries is important.

Table 25: LNG suppliers' positions, based on the criteria of the accessibility indicator

Supplier	LNG checkpoints to the EU	CPFER/GIRI (0–100)	The power of Organization (0–5)
Russia	Nil–one	LR (70–79.9)	CIS[8],APEC[9], GECF
Norway	Nil	VLR (90.7)	EFTA[10], OECD[11]
Iran	three	MR (60–69.9)	ECO[12], GECF
Algeria	Nil	LR (70–79.9)	UfM[13], GECF
Kazakhstan	Two strait and canal	LR (70–79.9)	CIS
Turkmenistan	Two strait and canal	N/A	Zero
The US	Nil	LR (70–79.9)	NAFTA[14],APEC, OECD

[8] Common of Independent States
[9] Asia–Pacific Economic Cooperation
[10] European Free Trade Association
[11] Organization of Economic Cooperation and Development
[12] Economic Cooperation Organization
[13] Union for the Mediterranean
[14] North American Free Trade Association

Venezuela	Nil	HR (50–59.9)	OAS[15], Mercosur, GECF
Nigeria	Nil	MR (60–69.9)	ECWAS[16], GECF
Australia	Two	LR (70–79.9)	APEC, OECD
Indonesia	Two	MR (60–69.9)	APEC, ASEAN[17]
Malaysia	Two	LR (70–79.9)	APEC, ASEAN
Trinidad	Nil	LR (70–79.9)	ACS[18], GECF
Saudi Arabia	One & three	VLR (80–100)	GCC
The UAE	Three	VLR (82.5)	GCC
Qatar	Three	VLR (80–100)	GCC, GECF
Libya	Nil	MLR (60–69.9)	UfM, GECF
Egypt	Nil	HR (50–59.9)	UfM, GECF
R. Azerbaijan	Two strait and canal	LR (70–79.9)	CIS, BSEC[19]

* Very Low Risk (VLR); Low Risk (LR); Moderate Risk (MR); High Risk (HR); Very High Risk (VHR);

Source: By Author, based on: GIRI; PRG Group Inc. 2011; the US EIA website; G. Victor et al, Natural Gas and Geo–politics, from 1970–2040, 2006: 27–49 & 407–439.

The International Country Risk Guide in the main gas holders during the past five years or so shows that the situation of the Composite Political, Financial, Economic Risk Rating has been better. For example, the Russian and Algerian index has improved from moderate to low risk. Most of the Sheikdoms in the Persian Gulf region have been situated in very low risk positions in the global ranking. It represents the fact that the relative unrest in the Persian Gulf has not had much effect on the Arab risk investment, while the index in Iran has decreased, to some extent, compared to around six years ago. So, Iran, Egypt, or any other gas holder, could improve their positions in the Composite Political,

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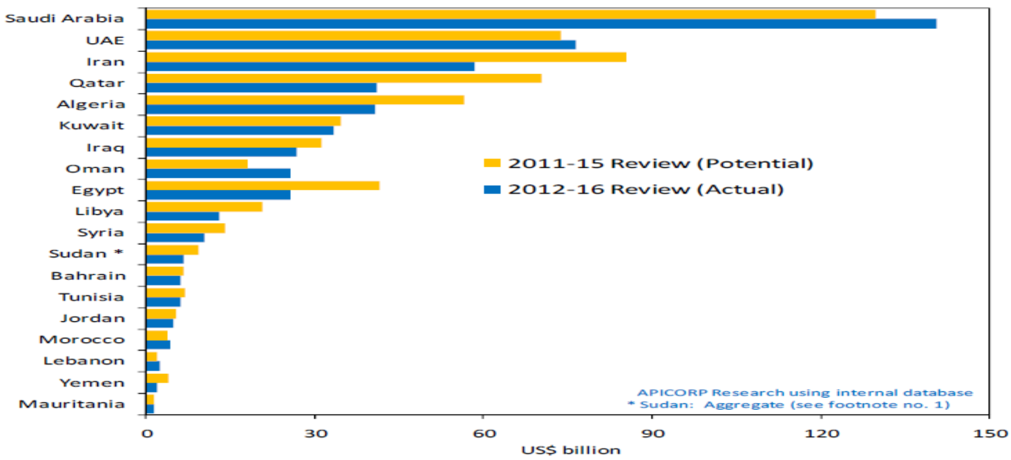
[15] Organization of American States
[16] Economic Community of West African States
[17] Association of Southeast Asian Nations
[18] Association of Caribbean States
[19] Black Sea Economic Cooperation

Financial, Economic Risk Rating, like their neighbours. As Clément (interview, 2012) said, Iranian natural gas and LNG developments require to an improvement to the internal political climate in order to attract the desired investment in the hydrocarbons sector.

APICORP (Arab Petroleum Investments Corporation) Research in its recent study, published in October 2011, regarding the five-year review of energy investment in the Middle East and North Africa (MENA), argued that a little more than two–thirds of the potential energy capital investment is located in the five regional countries, comprising Saudi Arabia, the United Arab Emirates, Iran, Qatar and Algeria, none of which has faced the sort of upheaval witnessed in some other Arab countries. However, tighter international sanctions against Iran could lead to the retreat of foreign companies and energy investment (Economic Commentary (2011), Vol: 6, No: 9–10, September–October).

Figure 69: Actual and potential investment in MENA, 2011–2016



Source: APICORP Research, Vol: 6, No: 9–10, September–October 2011: 2

5.2.4.2. The main sea checkpoints

Another factor in the above table refers back to the main global checkpoints, as the narrow channels along widely used global sea lanes that will grow more in the future by increasing LNG trading, according to Geoffrey Kemp (2012). So, these checkpoints are a critical part of global energy security (Pascual & Zambetakis, 2010: 14), while the Strait of Hormuz, leading out of the Persian

Gulf. The Strait of Malacca crossed by more than 80 per cent of Japanese and Korean as well as half of all Chinese oil and LNG supplies (Sascha Muller–Kraenner, 2007: 23), linking the Indian and Pacific Oceans and these are two of the world's most strategic checkpoints. So, for ships heading towards Asia, the Strait of Malacca is a probable waterway and for destinations to the Western countries, Bab El–Mandeb, en route to the Suez Canal faces additional bottlenecks. The international energy market is dependent upon reliable transport and the blockage of any checkpoint, even temporarily, can lead to substantial increases in total energy costs. While the seven straits are highlighted as major trade routes for global energy transportation, Kemp believes (2012) piracy and terrorist attacks by extremist groups are the main menaces against LNG trading and Bab El–Mandeb, between Somalia and Yemen, is the most dangerous waterway globally.

According to the US EIA, LNG transit through the Suez Canal has increased since 2008, from approximately 210 to over 500 in the total number of tankers and nearly six–fold in the volumes of LNG transportation. So, some EU countries, such as the UK, Belgium, and Italy, received over 80% of their total LNG imports via the Suez Canal in 2010, and France had about a quarter of its required LNG through the Canal. As a result, the Strait of Hormuz, the Suez Canal and Bab El–Mandeb are the three main waterways for LNG cargos heading towards the US and the EU.

Map 12: The global sea straits

Source: The US EIA website

Regarding the main gas holders in Central Asia and the potentiality of them for LNG export to the EU, the Caspian and Black Seas link to each other by the long– distance Volga–Don Canal, and any vessel from the Caspian littoral states should pass from this canal to the Black Sea and then head towards the south EU's LNG terminals via the Turkish Bosporus strait, although, President Nazarbayev of Kazakhstan has proposed the nearly 700km Eurasia Canal project between these two seas.

In addition, LNG trading connects different exporters and importers with each other directly without any transit players, despite some strategic checkpoints, so the agreements between two players could be more easily achieved, rather than with various actors (H. Hayes & G. Victor, 2006: 27–49).

In the last three decades, there have been about 40,000 LNG voyages worldwide (Melhem, 2005) and apart from some accidents, such as Ohio, the US in 1944; Arzew, Algeria in 1977; Cove Point in the Straits of Gibraltar in 1979; Bontang, Indonesia in 1983; and Skikda, Algeria in 2004 there has not been any other tragic accident in LNG facilities, while after the 9/11 attacks, concern over LNG carriers rose as they were considered prime targets for terrorist attacks or hijackings. According to the shared study conducted by the European Conference of Ministers of Transport with OECD in 2004, the hijacking scenario is more probable and the main anxiety (Hurst, 2008: 10).

Some argue that LNG ships are not attractive targets for attacks, as methane is lighter than air and will be dispersed into the atmosphere in the event of leakage (Palm, 2007: 15). So LNG is not flammable until it is fully vaporised, mixed in the right proportions with air, and then ignited, therefore this combination events could be seen as the worst–case scenario. As a result, there has never been an attack against either an LNG terminal or tanker, while maritime terrorism has been a core part of Al–Qaeda's strategy (Palm, 2007: 4).

However, marine transport faces security problems and trade disruptions due to sea–lane checkpoints, such as the Straits of Hormuz and Malacca, particularly the former, according to El–katiri (2012). Richard Perle, from the US think–tank

American Enterprise Institute, discussed the links between terrorist threats and energy infrastructure, among other geopolitical issues that might disrupt the energy access (Perle, 2005: 53).

Security of gas supply will be more rapidly achieved by diversifying of natural gas and LNG suppliers and the number of infrastructures, like liquefaction facilities, that specify the amount of exports to consumers (G. Victor & H. Hayes, 2006: 319–357).

Indeed, a quick glance at the main gas producing areas shows that the Middle East/Persian Gulf is a region with regional controversies of religious, historical, ethnic, economic and geopolitical natures besides political volatility (Chapter 3). At the same time, it consists of mainly authoritarian or autocratic regimes, as has been clear in Arab uprisings since the beginning of 2011 (Proedrou, 2012).

The former Soviet Republics have similar problems. Military and authoritarian regimes in certain of these states make them as rather lesser reliable gas partners, while the government–owned companies are estimated to hold 55% of gas reserves (Cable, 2010: 79). The energy sector is mostly state–controlled in some Latin American gas holders and that could also increase concerns for the politicisation of energy trade (Proedrou, 2012).

So, according to Bahgat, (2011), “LNG has intense competition from pipelines”, but also from within the EU, on the basis of the comments of the President of Eurogas (Bosmans, 2007: 4). In addition, LNG demands in East Asia, such as in China, Japan, S. Korea and Taiwan, will increase, whereas the economic prosperity in these countries depends on energy imports, so that these countries will devote nearly 80% of the world’s LNG imports to themselves in the years to come, particularly from Australia, Indonesia, Malaysia and Brunei (Kandiyoti, 2008: 199).

The international dimension of the gas trade has faced some political risks, such as the political unrests in Indonesia in previous years, institutional instability in producing and transit countries, such as Russian conflicts with Ukraine and

Belarus, quarrels between governments, for instance between Algeria and the US in the 1970s (Jaffe & Soligo, 2006: 437–468), etc.

Moreover, by increasing the number of natural gas and LNG exporters and importers, as well as further development of the global gas market in the future, the gas players will try increasingly to reduce the investment risks, predominantly in infrastructure (Hartley & B. Medlock, 2006: 357–407). For instance the host governments could create some islands, for example, just for the LNG industry with the aim of ensuring a safe environment for investors, such as the first Russian LNG project in Sakhalin Island that is situated far from Moscow (G. Victor & H. Hayes, 2006: 319–357).

The role of the governments in the developing of gas markets strongly transforms from direct investor and constructor of infrastructures to facilitator of the markets for the companies and investors, mostly private ones by reducing the major risks, such as with the Arun project in Indonesia in the 1970s or Qatar during the 1990s (Jaffe & Soligo, 2006: 437–468).

5.2.4.3. Mismatch between liquefaction and regasification facilities worldwide

An insufficiency of the required natural gas and LNG infrastructures and facilities acts as an impediment against security of supply and the ever–growing demands, so the situation of the global gas markets necessitates sufficient investment during the next 35 years (Jaffe & Soligo, 2006: 437–468).

Regarding the mismatch between the number of liquefaction and regasification facilities under construction in the world, as the threatening parameter against the global security of LNG supply and high demand in the future (Proedrou, 2012), "Global LNG Information" in the newly–published report on May 2012 announced that for the time being, 10 liquefaction project are under construction worldwide, while Iran's LNG project has been suspended due to the sanctions and also six of the other projects, out of a total of nine, are in progress only in Australia. In addition, 19 more planned projects exist in different gas holders, although 3 of them, in Iran and Venezuela, have been on hold (annex 11).

On the other hand, 20 regasification projects are currently in progress in different countries, though 2 of them have been suspended. Of the total of 45 regasification plans currently under consideration in various countries, 21 of them have been suspended or cancelled (annexes 11–15).

This disproportionate amongst the number of liquefaction and regasification terminals both under construction and under consideration is obvious, whereas the current 9 liquefaction facilities (6 of them in one country) are versus 20 regasification projects. There are also 19 liquefaction plants either in progress or suspended compared with 34 similar regasification projects. These statistics are additional to the current 31 liquefaction terminals which are on stream as opposed to 89 regasification online facilities (annexes 11–15).

It seems this unbalance could threaten the global LNG supply in the future and could lead to a rise of the global gas price (Palm, 2007: 40), while the LNG demands will dramatically grow in the future throughout the world, in particular in the EU and Far East.

While the numbers of regasification and liquefaction facilities are unbalanced, the capacity of these terminals is more important. For example, the EU imported 80 bcm LNG in 2010, although these terminals have been capable of regasifying up to 150 bcm by virtue of the current expanded facilities (Eurogas, 2010: 5–6).

5.3. The EU and its proposed natural gas and LNG suppliers in the future

5.3.1. Expansionist mode in the EU's gas market

The EU will be the world's largest gas importer by 2030 (European Commission Working Paper, 2011: 2) and its market remains in an "expansionist mode" (R. Odell, 2002: 439), while the Member States should mostly try to substitute the coal and oil with gas, mainly in power generation plants in order to reduce greenhouse gases emissions (EU 2050 Energy Road Map, 2011: 17). In addition, the continuation of economic growth within the Union alongside fluctuating oil prices, mostly upward, will work to continue the growing role of gas in the future (Eurogas long– term outlook to 2030: 1).

This will involve an increase of nearly 100% in gas use in Western Europe and 150% rise in its use in the east of the continent by 2025 from estimates based on 1995 figures (table 26). As a result, during this 30 year period, Europe will need more than 16,000 bcm gas compared to a lower amount of around 5,000 bcm during the period from 1956–1995. Moreover, because of these levels of demand the cost of supplies in the longer–term could thus become a critical variable in the further expansion of the industry (R. Odell, 2002: 439).

Table 26: The evolution of European natural gas use by country, 1995–2025 (in bcm)

Country	Actual Use 1995	Potential Use in: 2005	2015	2025
a). Western Europe				
Germany	74	85	102	118
United Kingdom	73	95	105	116
Italy	48	72	90	104
The Netherlands	37	40	43	46
France	33	43	52	62
Belgium	11	16	20	25
Spain	8	18	25	34
Austria	7	10	11	13
Finland	3	7	9	10
Denmark	3	6	8	10
Ireland	3	5	6	7
Switzerland	2	4	5	6
Sweden	1	3	6	8
Luxembourg	1	1	2	2
Greece	negl.	2	5	8
Norway	negl.	2	3	5
Portugal	–	5	7	12
Sub-Total	*304*	*414*	*497*	*582*
b). Eastern Europe				
Romania	24	27	29	32
Poland	10	16	23	29
Hungary	10	14	16	22
Czech Republic	7	13	16	23
Slovakia	5	8	10	14
Bulgaria	5	6	8	11
Former Yugoslavia	4	6	8	11
Albania	negl.	2	3	4
Sub-Total	*65*	*92*	*113*	*146*
c). Overall Total	*369*	*506*	*610*	*728*

Source: R. Odell, P 2002, "Oil and Gas: Crises and Controversies 1961–2000", Volume 2: 440

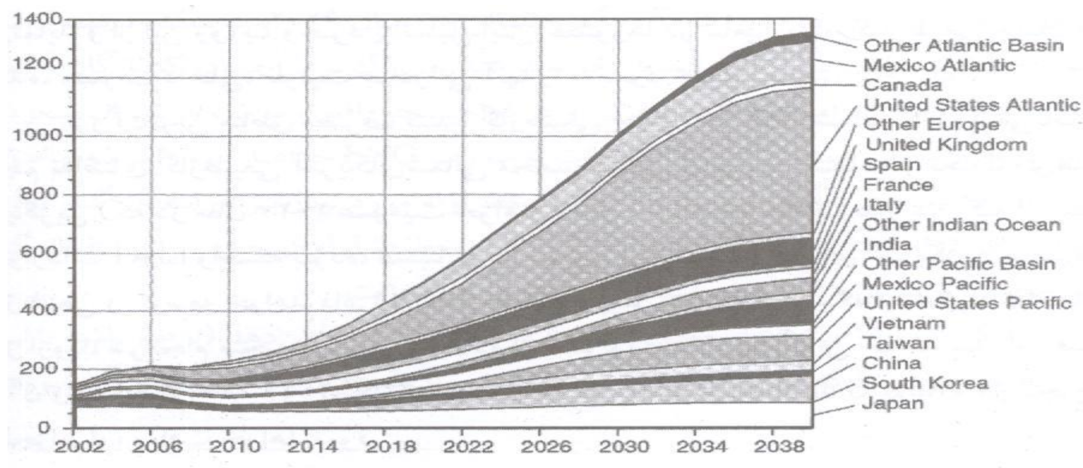
The share of natural gas in the EU energy mix was 24%, according to Eurostat, in 2011 and the EU has imported nearly 64% of its demand and this number will increase to 80% by 2020, while Denmark and the Netherlands were the only gas exporting countries among the EU–27 and could be expected to remain so at least until end–2018 and 2020 (Chapter 2).

In addition, the share of natural gas in some EU member states' energy mix is more than the Union average (figure 8), e.g. the Netherlands (43%), Italy (41%), the UK (40%), Spain (24%).

The Baker Institute has also issued The Baker Institute World Gas Trade Model (BIWGTM) and argued that five criteria determine the amount of natural gas and LNG demands in the future: comprising, "the rate of population, the level of economic development, the scale of gas reserves in that country or region, the relative price of other energy sources, and also the rate of progress in energy technologies" (Hartley & Medlock, 2006: 357–407).

As figure 70 shows, issued by BIWGTM, the EU is the second LNG consumer in the world, followed by Mexico Atlantic, Japan, China and other importers. The main EU entrances for LNG imports will be the UK, Italy, France and Spain by different regasification terminals whether existing, under construction or under consideration. So, according to IGU (World LNG Report in 2010: 25) the EU absorbed close to 20% of global LNG supply, and 85% of this volume was imported by the four above–mentioned members (figure 40). Therefore, this 20% of global LNG import by the EU was nearly 15% of the Union's gas demands in 2010, according to CEDIGAZ 2011 (figure 21) and this percentage will rise to 24% by 2020 and around 40% in 2030.

Figure 70: The main LNG consumers, 2002–2038 (in bcm)



Source: Hartley, Peter and B. Medlock, Kenneth 2006: 357–407

As discussed in chapter 4 and also in this chapter, the US will be the second global LNG producer during the next decades. However, this country will still remain the main LNG consumers with nearly half of the global demand, so its natural gas and LNG production from conventional and unconventional gases will mostly be consumed domestically.

Lochner and Bothe, regarding unconventional gas in North America, argued (2009: 1521) that while it impacts on the short–and mid–term development of the North American gas market, however, its effects on the long–term development are expected to be smaller, mostly because of its costs (see Chapter 4).

Therefore, the above figure, being prepared and published by James A. Baker III Institute for Public Policy at the University of Rice in the US, illustrates that the main LNG consumers will be the US and the EU, followed by Mexico Atlantic, Japan, China after around 2018 until 2038. However, the foremost consumer could produce LNG from unconventional gas, mostly, inside the country and will probably not need to import from external suppliers, unlike the other consumers, as the net LNG importers.

Peimani (interview, 2012), believes that, "in the absence of the American market (becoming self–sufficient in gas thanks to its shale gas industry), it is possible that the Qataris or other suppliers continue expanding their LNG export capacity to the Asia–Pacific, the EU and other markets, while the world's growing markets for LNG (e.g., China Indian and South Korea) needs to find new suppliers to ensure their demands in the future".

5.3.2. The estimated shares of gas holders in the global market, by 2040

On the basis of table 27 that has been prepared in accordance with some official data by BIWGTM, the share of some current main natural gas and LNG suppliers, such as Algeria, Kazakhstan, Malaysia, Brunei, Norway (to some extent), and Trinidad and Tobago will decrease during the period between 2010 to 2030 and also to 2040. According to table 27, apart from the mentioned suppliers, the rest of the world will hold 19% of natural gas and LNG exports, equivalent to around 30% and 40% less than this percentage in 2010 and 2020, respectively.

Table 27: The outlook of the main natural gas holder's share in global market, 2010–2040 (in %)

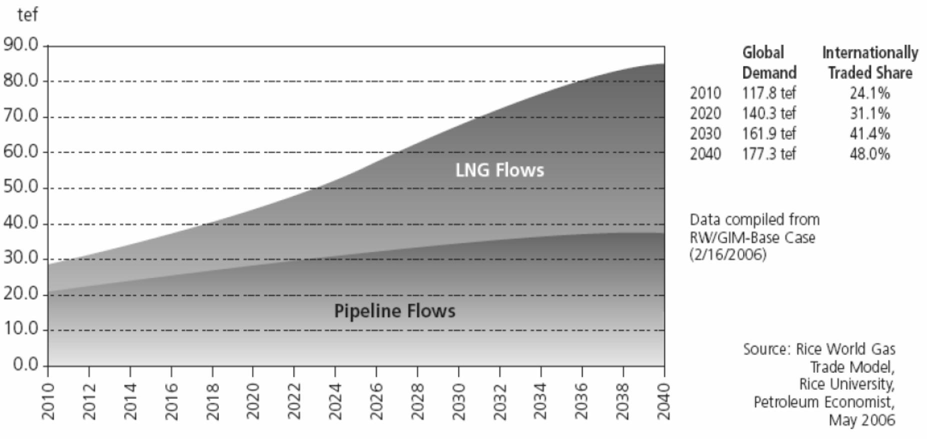
Gas Supplier	2010	2020	2030	2040	Gas Supplier	2010	2020	2030	2040
Russia	15.71	16.18	17.35	19.54	Indonesia	5.03	5.40	5.55	5.50
The US	_	_	_	slight	Australia	1.88	4.10	8.46	8.09
Norway	7.05	5.40	5.30	5.11	Malaysia	3.98	2.69	1.03	_
Iran	_	2.3	6.17	8.69	Trinidad	2.22	1.55	0.65	_
Algeria	11.3	6.72	1.89	0.20	Saudi Arabia	0.00	1.65	5.28	8.13
Canada	7.56	3.14	_	_	Angola	0.17	0.55	1.04	0.79
Kazakhstan	8.11	5.17	2.21	0.71	Qatar	3.47	4.68	7.87	9.50
Turkmenistan	3.17	3.11	3.65	4.55	Greenland	_	_	_	2.12
Nigeria	2.99	6.64	7.04	5.33	Venezuela	_	1.63	3.68	3.15
The rest of the world						26.31	30.10	24.69	19.00

Source: by Author, on the basis of: G. Victor et al, Natural Gas and Geo–politics, from 1970-2040, 2006: 439–467, BIWGTM; US EIA, Annual Energy Outlook 2012: 12

The figure 71 demonstrates that on the basis of LNG supply in 2010, this wave grows close to 200% by 2020, around 350% in 2030 and up to 500% by 2040.

In another view, LNG trading, compared to piped gas flows, will increase from 24.1% in global gas trading in 2010 to 31.1% by the end of the present decade and then be upward to 41.4% and 48% until 2030 and 2040, respectively.

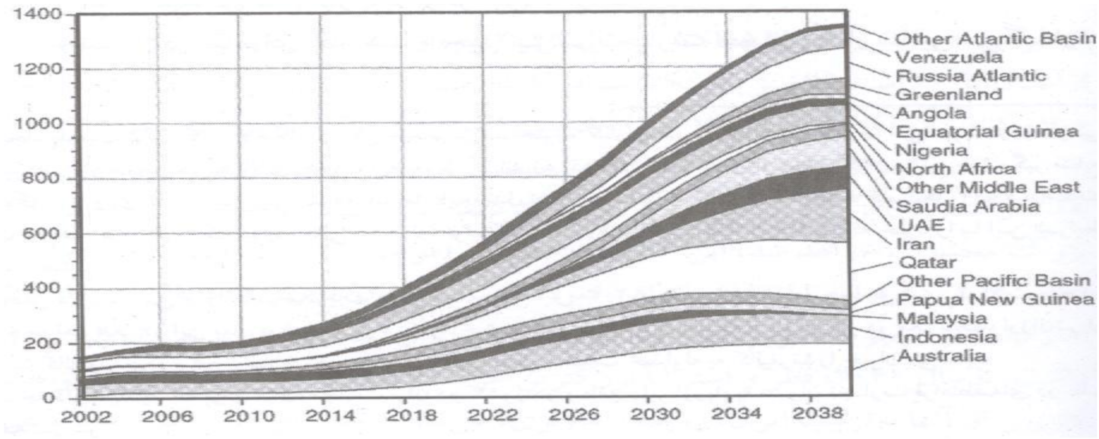
Figure 71: Global natural gas and LNG exports, 2010–2040



Source: Bosmans, 2007: 7

In another discussion, while Qatar, Iran, Australia, Russia, Indonesia, Saudi Arabia will be the leading exporters, followed by the United Arab Emirates, Venezuela and Nigeria by the second half of the future decade (figure 72). Nevertheless, some regions, such as North Africa and some countries in Asia–Pacific, like Malaysia and Brunei, as well as in Latin America, for example Trinidad and Tobago will encounter depletion of reserves by the end of the next decade.

Figure 72: The main LNG suppliers, 2002–2038 (in bcm)



Source: Hartley, Peter and B. Medlock, Kenneth 2006: 357–407

In an interview with Inge Bernaerts, the Head of Unit Electricity and Gas, DG ENER for the European Commission, on 2nd April 2012, it is argued that the quantity of LNG imported in the EU from Qatar has been constantly increasing during the past years. However, it is difficult to predict how this trend will evolve in future. "The amount of gas imported and choice of suppliers stays with commercial entities and are not steered by EU institutions. The role of institutions is to create a stable, clear and predictable legislative framework so that energy and gas companies can adequately plan and realise their investments".

Gunther Oettinger, the EU Commissioner for Energy, in his two discourses in the 3rd Secure Regional Workshop in Manama, Bahrain, on 9th November 2010; at "Conference on Energy Security Potential for EU–GCC Cooperation" and also in Brussels on 10th November 2010 regarding the new EU energy 2020 strategy discussed the EU's growing natural gas and LNG demands, as well as new challenges on energy security in the future.

In the former summit, he referred to the Union's growing gas imports when its indigenous resources decline and also that some gas disputes, such as in 2006–9 might recur in the future, considering this to be the "exporters' reliability risk" (Checchi et al. 2009: 43).

Consequently, Oettinger argued that decline of security of energy supply by more dependency on gas imports from one country, is the major energy challenge within the EU in the future (accessibility).

Anne Korin (2012) said that "apart from political problems, like sanctions and just looking at the economics, the EU has to weigh between the option it knows and does not like (Russian gas, piped in, contracts subject to manipulation) and a future option, which has the appeal of diversification of suppliers and sources".

5.3.3. The results of testing of the energy security indicators on LNG suppliers to the EU

On the basis of testing the four energy security indicators on different current and future LNG suppliers toward the EU in this chapter, the following table could categorise and summarise the relevant data.

Table 28: The results of testing of energy security indicators on LNG suppliers toward the EU

Supplier	Acceptability	Availability		Affordability			Accessibility		
	Pure methane	Volume	Field(s) size	Production	Liquefaction	Transportation	Check point	CPFER	Organization
Algeria	C	D	D	B	B	C	A	B	B
Australia	C	D	E	B	C	N/A	C	B	A
Egypt	B	E	E	B	C	C	A	D	B
Indonesia	C	D	E	B	B&C	N/A	C	C	A
Iran	C	A	A	A	A	E	D	C	C
Kazakhstan	C	E	D	N/A	N/A	N/A	C	B	C
Libya	C	E	E	A&B	C	A	A	C	B
Malaysia	C	E	E	N/A	E	N/A	C	B	A
Nigeria	C	D	E	B	E	E	A	C	D
Norway	C	E	E	E	C	E	A	A	A
Qatar	C	A	B	A	A	D	D	A	C
R. Azerbaijan	C	N/A	D	B	N/A	N/A	C	B	B
Russia	A	A	A	A&B&C	A&C	N/A	B	B	A
Saudi Arabia	C	C	E	N/A	E	E	B&D	A	C
Trinidad	B	E	E	B	B	E	A	B	B
Turkmenistan	C	C	D	A&B	N/A	N/A	N/A	N/A	D
The UAE	C	C	E	A	E	E	D	A	C
The US	N/A	C	D	N/A	N/A	N/A	A	B	A
Venezuela	C	D	E	B	B	E	A	D	B

Source: by Author

As the table 28 shows, for the acceptability, on the basis of different data in the mentioned section, the letters E, D, C, B and A were considered for diverse LNG suppliers with 60%, 70%, 80%, 90% and 100% methane in their exports.

In the availability columns, the volume of natural gas reserves in each supplier and the size of gas field(s) are important, so the letters A, B, C, D and E were employed for the countries with 900–1700 tcf, 300–900 tcf, 200–300 tcf, 100–200 tcf and under 100 tbc gas deposits, respectively.

Regarding the size of the natural gas fields, the top 21 largest fields were examined. Moreover, some countries hold more than one huge natural gas field in this ranking, therefore the total of these fields for those countries were counted. Consequently, the letters A, B, C, D and E were applied to the fields with over 20,000 km^3, 10,000–20,000 km^3, 3,000–10,000 km^3, 1,000–5,000 km^3 and under 1,000 km^3.

The third indicator for the energy security is affordability and the cost of production with the average of the lowest and highest production costs for each gas holder, the cost of liquefaction and transportation costs were considered. So, the letters A, B, C, D and E were used for the countries under \$0.40, \$0.40–\$60, \$0.60–\$0.80, \$0.80– \$1.00, and over \$1.00 in MBtu production respectively.

In the liquefaction part, the above–mentioned letters were considered for the gas suppliers up to \$180, \$180–\$190, \$190–\$200, \$200–\$210, and over \$210 in one thousand cubic metres. The last dimension of affordability is supply and transport costs. The letters A to E were employed for various LNG suppliers to the EU with transportation cost of 1.40\$ - 1.60\$, 1.60\$ - 1.80\$, 1.80\$ - 2.00\$, 2.00\$ - 2.20\$ and over 2.20\$ in MBtu, respectively.

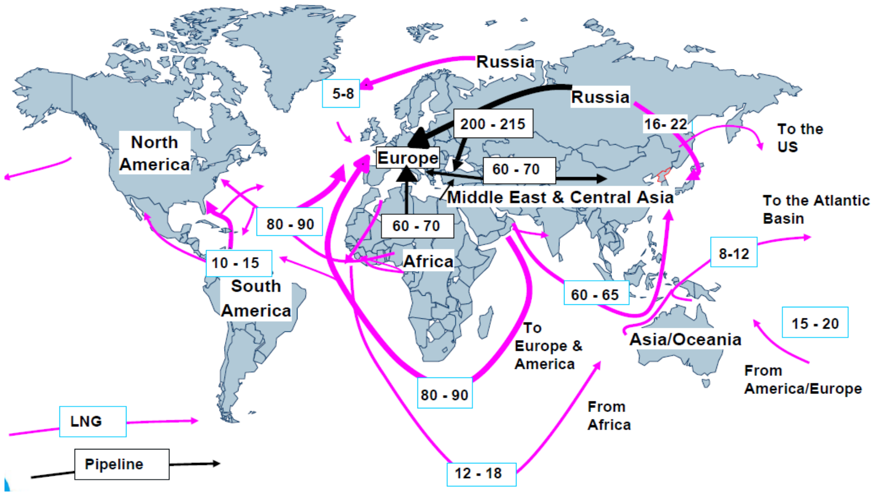
Accessibility is the fourth indicator of the energy security with three criteria: the number of sea checkpoint(s), the International Country Risk Guide/Composite Political, Financial, Economic Risk Rating, and the power of organization. Hence, on the basis of the number of checkpoints along the LNG routes from each supplier to the EU, the letter A is used for the LNG routes without any checkpoint, followed by the letters B to E for one to three and above. Regarding the International Country Risk Guide/Composite Political, Financial, Economic Risk Rating, the letters A to E were employed for either very low, low, moderate, high, and very high risks. Finally, the power of regional organization is the last criteria for accessibility. Hayes and Victor (2006: 3–27) categorised and ranked different regional organizations by numbers, so the letter A could be applied to APEC, OECD, EFTA, NAFTA, and ASEAN; the letter B for Ufm, OAS, Mercosure, ACS, BSES; the letter C for GCC, CIS, ECO; the letter D for GECF, ECWAS; and the letter E for any gas holder without membership in any organization.

As regards the EU, the region is surrounded by over 75% of all proven natural gas reserves. Most of them are situated in Russia, Middle East/Persian Gulf, the so–called "strategic ellipse" (Sascha Muller–Kraenner, 2007: 4), Central Asia, and North Africa. So, experts estimated a growing focus of supply from less stable regions and countries–Russia, the Persian Gulf, Algeria and increasingly West Africa (Young, 2009: 2).

Russia: Geographically focused on pipeline developments, although transit problems and aspirations to become a global player have led to Russian interests in LNG developments in the Atlantic basin, plausibly from the Shtokman field in the Barents Sea and also on the Yamal peninsula. It seems that Moscow has strengthened its position amongst other actual and potential suppliers toward the EU, but probably not in LNG exports.

As is obvious on map 13, North and Western Africa alongside natural gas and LNG suppliers within the Persian Gulf, as the main ultra–regional exporters, will both be in the second position of trading towards Europe in 2020.

Map 13: The growing role of global gas trade by 2020, while inter-regional flow just 605 bcm



Source: CEDIGAZ (2011), "World LNG market: current developments and prospects", 24 June: 15

Algeria: Both geographically and economically a gas exporter to the EU via pipelines and LNG tankers, Algerian LNG is expected to be still foremost and more competitive than other Mediterranean LNG suppliers to Europe in the future (Lochner & Bothe, 2009: 1525). There are plans for more LNG capacity, like the refurbishment of the Skikda plant and the planned Gassi Touil project. The Algerian Government aims to export 85 bcm natural gas in 2012 and around 100 bcm in 2015 by pipeline and LNG to Europe (Wicks, 2009: 37).

The Middle East/Persian Gulf: Iran and Qatar, as the second and third gas holders worldwide will be the most important suppliers to the European market, additional to some other exporters within this region. Qatar is the most prominent of all and has become the world's number one LNG supplier. Consequently, on the basis of the figure 72, Qatar, Iran and Australia will hold around 50% of global LNG exports by 2040, while the first two countries could play an important role to connect regional gas markets with each other to emerge a global gas trading system.

The Middle East/Persian Gulf is near to the growing South and South–east Asian LNG markets, as well as the EU ones, so more attention to Iran (Sascha Muller–Kraenner, 2007: 78) and Qatar, as the two important regional gas holders, reflects their strategic positions (Hartley & Medlock, 2006: 357–407).

With regards to supplies to the EU, as the primary importer followed by Asia and the US (MIT report, 2012: 68), Iran has two options: pipeline gas by Tabriz–Erzurum and connection to the planned Nabucco project or extension by Turkey and then to the EU, and also LNG. LNG currently seems to be favoured by Iran (see Chapter 4). If political hurdles can be overcome, this route is much attractive for the EU. However, the Asian market is geographically equally attractive as the EU for LNG suppliers in the Middle East/Persian Gulf.

Central Asia and Caspian region: Not yet a direct supplier to the EU, except from Republic of Azerbaijan, but the ambiguous Nabucco project is an attempt to transport Central Asian, Iran and Iraq natural gas through the Caucasus and Turkey, by–passing the Russian pipeline network.

The European Commission suggests that a southern gas corridor must be developed for the supply of gas from Caspian and Middle East/Persian Gulf sources, as one of the EU's highest energy security priorities, while the latter has remained fundamental to European energy security (Young, 2009: 51). So, the European Commission and Member States need to work with the countries concerned, such as Republic of Azerbaijan, Turkmenistan, Iraq, Uzbekistan and Iran (European Commission 2008, Second Strategic Energy Review: 5).

West Africa: Apart from some regional pipeline supplies, West Africa, notably Nigeria and Angola will be two LNG suppliers. Nigeria hopes to transmit 20–30 bcm to Europe from 2015, despite security difficulties in the Sahel and Delta regions (Wicks, 2009: 37).

Caribbean region: Trinidad and Tobago started originally with part of its supplies destined for Europe and part for the US, but today it predominantly supplies to the US market. Venezuela, with ample gas reserves, would be a potential LNG exporter, despite its political problems. However, the proposed Mariscal Sucre LNG project is still merely a proposal. The region is better placed geographically to supply the North American market than the European market.

In addition, the South American gas suppliers will play the least important role in the global gas market in the future and this region will be neither a natural gas and LNG importer nor exporter, just involved in intra–regional gas trading. According to the figure 72, unlike Australia, some of the natural gas and LNG exporters within the ASEAN will be amongst the major exporters by 2025 and after that they will be likely converted in to importers (Hartley & Medlock, 2006: 357–407).

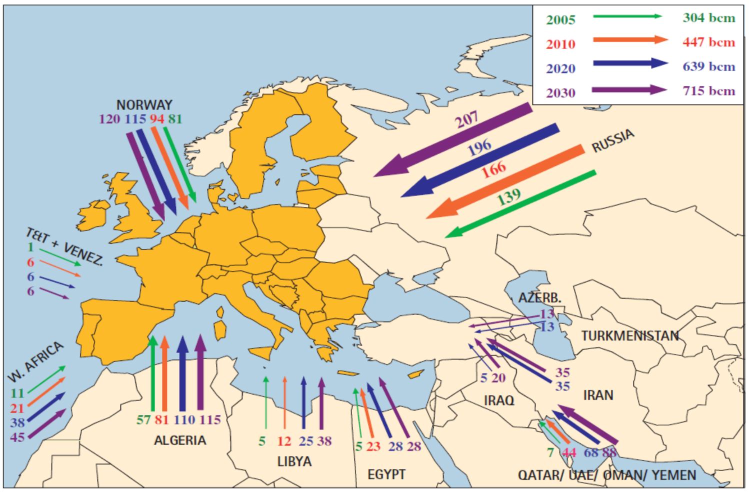
Sascha Muller–Kraenner argued (2007: 97) that the EU is supposed to give preference to the "Monnet method" in its energy–political cooperation with its neighbours. Under these circumstances, international agreements, mostly individually, within the framework of joint institutions based on a legal basis for current energy competition sound appropriate.

Russia, the US, Iran, Qatar, Algeria, Norway, Nigeria, and Australia will be amongst the 10 top natural gas and LNG producers by 2030 (annex 7 & table 24) but Russia, Norway and Algeria are expected to be the main exporters of gas toward the European market (Catalano, 2011: 9), followed by some other non–EU LNG suppliers, such as Iran, Republic of Azerbaijan and the like.

The European Commission (EUR 22581, 2007: 20), based on its data in addition to CEDIGAZ, Oil and Gas Journal, Norwegian Petroleum Directorate, and OME predictions, argued that the EU's potential main suppliers have significant reserves that will enable them to increase their productions and meet Europe's gas demand in the future.

According to this report, different natural gas and LNG suppliers will increase their exports toward the EU during the period between 2005 and 2030. Nevertheless, the most increase in gas exports belongs to the Persian Gulf region that would be more than 12 times in 2030, compared to 2005.

Map 14: The shares of the main natural gas and LNG suppliers towards the EU, 2005–2030



Source: European Commission, EUR 22581, 2007: 20

The European Commission in a non–published study in preparation for its Energy Green Paper emphasised that "competition with Japan, China, India, etc. over oil and gas from the Persian Gulf and Russia will become tougher in future" (Sascha Muller–Kraenner, 2007: 24), particularly the former (Young, 2009: 53). However, during the recent years, the EU gas approach in the Persian Gulf has drawn less priority than in policy towards Russia (Young, 2009: 78).

Richard Young believes (2009: 4) that the EU has struggled to match the US' direct security engagement and in some producer regions, the Union remained slow in strategic competition compared to China, Russia, etc.

Needless to say that if any pipeline projects in the future do not materialise, such as the Russian pipeline to North–east Asia, the role of actual and potential LNG suppliers, even with the higher cost, would be increasingly important (Hartley & Medlock, 2006: 407–439).

The more the market is open, the better the energy security situation will be, so, if new LNG suppliers enter the EU gas market, this would influence the current suppliers' market power and shares (Palm, 2007: 68). While Qatar and Algeria have been the main LNG suppliers to Europe, nevertheless, the continental imports in the future will, mainly, originate from the Middle East/Persian Gulf and North/West Africa, according to CEDIGAZ (2011: 15).

So, both economic (geographical proximity, technology, low prices), as well as political criteria (cooperation or conflict with friendly and unfriendly states) are important for the EU in choosing its LNG suppliers (Proedrou, 2012), while Inge Bernaerts (interview, 2012) believes that, "political stability and full respect of the International Treaties have been counted as two more essential conditions to develop gas relations with the EU".

Geoffrey Kemp argued (2012) that the ellipse between the Mediterranean Sea to the Hindu Kush mountain range is full of gas reserves, but the biggest conflicts and disputes also happen in this huge area.

As a whole, pursuit of diversified sources, suppliers, routes of supply, as well as more investment in the main gas holders' LNG facilities could play significant roles to minimise risks and vulnerabilities for the EU, whereas the increase in the size of the Union's LNG market for imports will become considerable in the future. Likewise, any adopted policy that lessens political tensions and promotes regional energy cooperation is the best criteria against the threat for the energy security of the EU (Sascha Muller–Kraenner, 2007: 25). Therefore, these situations could lead to oversupply of LNG toward the EU and easier access to the required natural gas by 2030 and even beyond.

5.4. Conclusion

Energy has always been seen as a matter of security, while security of gas supply has become important since the 1990s, with a rise in consumption in recent years and also expected in the future, in particular within the EU. So, energy security is defined as uninterrupted physical energy supply to meet the growing demands over a period of time at reasonable prices, while respecting environmental concerns.

As a result, acceptability, availability, affordability and accessibility are the main indicators for the energy security that imply the environmental and social, geological, economic, as well as geo–political elements.

On the subject of acceptability and the percentage of methane of LNG in various suppliers, Russian gas is the first, followed by Egypt and Trinidad and Tobago and the percentage of LNG cleanliness in other global suppliers are at the relatively same level.

Regarding availability, the volume of natural gas reserves in each gas supplier and the size of gas field(s) are important. According to attained results, the Persian Gulf has the richest gas reserves and also the most extensive natural gas fields worldwide, followed by Russian and Caspian Sea gas deposits. So, while Russia holds the highest percentage of global reserves and Iran, as well as Qatar stand in the next positions, Iran has the widest gas reserves in the world, followed by Russia and Qatar.

The cost of production and supply cost are two criteria of affordability. The lowest cost–to–production belongs to the Persian Gulf, including Iran, Qatar, and the United Arab Emirates. Russian reserves, Caspian Sea and North African gas holders are situated in the second global position in this regard. Supply cost, moreover, is divided into liquefaction, transportation and regasification sections.

In terms of liquefaction, Qatar, Iran within the Persian Gulf, and Russian, excluding gas reserves within the Russian Barents Sea, are the leaders, followed by North African Algeria, Latin American Trinidad and Tobago, and Asian Indonesia.

The most suitable LNG transportation prices relate to North African suppliers, particularly Libya, however, the Persian Gulf, West African, South American and Asia–Pacific suppliers are regarded as having the least–cheap shipping costs toward the EU.

Nonetheless, the cost of Norwegian supply gas in the 2020s will be high due to need for new investments in the expensive gas fields, too.

Accessibility is the fourth indicator of the energy security with three criteria, the number of sea checkpoint(s), the International Country Risk Guide/Composite Political, Financial, Economic Risk Rating, and the power of organization.

Concerning the sea checkpoint(s), North African and American suppliers alongside Norway have the least number in their LNG shipping routes toward the EU, whereas the Persian Gulf suppliers should send their vessels through three major checkpoints. Regarding the International Country Risk Guide/Composite Political, Financial, Economic Risk Rating, Norway and Arab Sheikdoms within the Persian Gulf have the best position globally, followed by Russia, some Caspian littoral states, Algeria, Trinidad and Tobago and Asia–Pacific, except Indonesia. The highest risk investment belongs to Venezuela and Egypt, while Iran is situated in the middle of this ranking with moderate risk investment. It demonstrates that, aside from Iraq, Iran has the highest risk investment among other gas holders within the Persian Gulf and this country should try to improve its conditions more domestically than regionally.

Accordingly, it is expected that Russia, the US, Iran, Qatar, Algeria, Norway, Nigeria, and Australia will be amongst the top 10 gas producers by 2030. Moscow, as the existing EU's largest supplier, will most likely strengthen its position and Algerian LNG is predicted to be still foremost and more competitive than other Mediterranean LNG suppliers to the Union in the coming years. In addition to Russia and Algeria, other suppliers, comprising Qatar, Iran, Australia, Indonesia, and Saudi Arabia will be the leading global LNG exporters by the end of the next decade, followed by the United Arab Emirates, Venezuela and Nigeria.

Global gas consumption will increase by almost 50% by 2030 and LNG demands will rise to 200% by 2020, 500% in 2030 and even more beyond that date. So, in order to meet this demand, the world's gas producers should raise their supplies and some new exporters must be added in order to fill the demand–supply gap.

Chapter 6. Final Conclusion

Energy is the motor behind growth and development and has always been regarded as a matter of security and will be the most significant challenge during the 21st century. On the other hand, energy security is threatened nationally, regionally, and globally by some dangers, such as decrease of global reserves, fluctuations in energy prices, and growing global competition for energy access, the rise of greenhouse gases, disruptions of energy supplies, while any failure to ensure energy security could lead to an energy crisis.

The European Commission has concentrated more on the energy security since the 2000 Green Paper on "Security of Energy Supply" and defined this term having common main features with other definitions by energy organizations, institutions, and scholars: "Energy supply security must be geared to ensuring…the proper functioning of the economy, the uninterrupted physical availability in short, medium and long–terms …at a price which is affordable… while respecting environmental concerns… security of supply must seek to reduce the risks of energy dependence".

For importers, energy security means security of supply without any energy shortage at reasonable and even competitive prices without further deteriorating the state of the environment. For exporters, on the other hand, "energy security equates with security of demand at affordable prices that will guarantee significant profits for the exporter with no excessive cost to the environment".

Energy security, moreover, has four regular indicators, comprising acceptability (environmental and social elements); availability (geological aspects); affordability (economic criterion) and accessibility (geo–political dimensions) and realisation of these criteria could ensure security of energy supply.

This term had, traditionally, concentrated on crude oil supply disruption by the end of the Cold War. However, since the 1990s, natural gas increasingly became "the fuel of choice", due to high oil prices, political instability within the oil market, function of the cartels like OPEC, discovery of new giant gas fields, the least–carbon intensity of natural gas, technological innovations, technological growth in unconventional gas and the like; therefore, “Gas is the new oil”. Therefore security of gas supply has entered the global energy literature, while natural gas is more coincidental with energy security indicators, compared to other fossil fuels.

The global energy mix will change between 2010 and 2030, primarily to renewable energy sources, followed by natural gas. As a result, the share of the former will increase to around one third of total primary energy sources worldwide, while the latter is the fastest growing fossil fuel throughout the world. It seems that natural gas acts as the main bridge for the transitional era to renewable energy sources for global use. So, the global gas demands will increase around 50% by the end of the next decade and its share in the global energy mix will rise from 21% in 2010 to 25% in 2030.

The unconventional gasrevolution could reshape the global gas system, providing that the US will no longer need to import natural gas and LNG in the future, while according to projections, more than 75% of the US’ gas production comes from unconventional gas. However, unconventional gas faces some environmental, financial, ecological and infrastructural constraints. Nevertheless, apart from these restrictions, production of unconventional gaswill grow from 13 tcf in 2008 to 31 tcf in 2035, in particular in the US, with more than 85% of global production in 2009 and 75% in 2030, followed by Canada, Russia, China and Europe. Unconventional gas might be commercially more important around 2030 in Europe with just more than 1% of global NG production. It is essential to mention that the percentage of unconventional gasin the global gas market will be under 18% by 2030 while this number was 12.5% in 2010 and will be 15% in 2020 and then rise up to 17.95% by 2030.

Energy was also a cornerstone of European integration and has always been a shared issue among the European countries, leading to the grand EU’s energy policy approval by its “energy trinity”, comprising emergence of the competitive internal market, environmental/climate change, and security of supply together to prepare the Union for the 21st century energy challenges, as well as

Europeanisation of energy by the increasing of the renewable energies share in the energy mix.

The EU's energy security has been influenced by both internal and external factors, comprising fluctuation in energy prices, declining European gas production, fragmented internal energy, newly–emerging economies with dramatic growing demands, political instability in gas suppliers, as well as some transit states, the threat of terrorist strikes against infrastructure, any possible disruption of gas supply by natural or political reasons, and more dependence on special suppliers.

The EU, with the 27 independent countries at present, is united under one European institutional structure, while sustaining national sovereignty. Nevertheless, this most integrated region worldwide might be enlarged even further with some potential new members in the future.

This kind of integration could emerge on the basis of different aspects, ranging from economic, cultural, political, and social characteristics to security aspects, leading to regionalism. If any non–state actors, organizations, institutions and social groupings, in addition to the states, play important roles in this process, then "new regionalism" can be established and the EU is the best example of this.

Although energy, as a matter of security could be one criterion causing some states to from a closer relationship around the issue of energy, it was a cornerstone of European integration after the Second World War and has already been a common issue amongst the European countries.

The new energy paradigm within the EU insists on energy efficiency initiatives, more use of renewable energy sources, and security of gas supply.

The EU's decision concerning the increasing use of natural gas in its industries, particularly power generation, has been in operation since 1992, though the Union has tried to move to a low–carbon society by energy efficiency and renewable energies since 1997.

This region has converted to the second gas consumers throughout the world since the middle of the 2000s. Accordingly, 11 member states out of the EU–27 import the total of their gas needs and 9 more import more than 80% of their required natural gas from other suppliers, and, as a result apart from Denmark and the Netherlands, the whole of the Union's members are natural gas importers. Therefore, natural gas will be the "Achilles heel of the EU's energy security", according to Herbert Ungerer, Director DG ENERGY for the European Commission and this organization, in its published Green Paper in 2001, describes the situation of natural gas within the Union as the "Gulliver in chains". The Green Paper, 2000, also predicted a greater reliance on gas import in the future, around 80% of natural gas needs in 2030.

It is important to mention that the EU has tried to shift its members' unilateral energy policies towards a regionalised energy approach and form a united front to reinforce its regional energy security. So, the European Commission would be the major policy–maker organization regarding energy issues with the help of some other regional and non–governmental bodies.

As a result, the main energy policies and actions within the EU have been enacted and implemented regionally, for instance:

– The EU's grand energy policy to ensure the regional energy security;

– Various adopted policies, such as the "Europeanisation" of energy, the creation of a single gas market in the future, the Energy Charter Declaration, the Commission's White Papers, "Diversification" of energy suppliers and sources, etc.;

– Some actual and potential regional initiatives between the EU and some other gas–rich neighbours and partners, such as the Euro–Med Energy Forum and the EU–GCC Partnership.

On this basis, the "new regionalism" theory has been the most proper theoretical framework for the EU to analyse the situation of the regional gas policies.

The EU's growing need to shift fuels in order to achieve the target of the climate change policy is a major energy challenge during the coming years given the relatively high price of renewable energy technology. The EU–27's renewable energies share in total primary energy sources is set to rise from 9.2% in 2006 to 15% in 2015 and then 20% up to 2020. Most of the EU member states have a long way to go to achieve the renewable energies target for 2020, while 16 out of 27 should promote their own non–hydrocarbon sources use between 200% to more than 1250% by the end of the current decade.

Regarding nuclear power, a number of EU members, like Germany, Belgium, the Netherlands, Sweden and Spain, have committed to phase out their nuclear reactors by 2020 and replacing them with gas–powered facilities.

It seems that natural gas will be the "Achilles heel of the EU" and energy security within the EU means security of gas supply, as the "Gulliver in chains", so the shortest way to aim to ensure security of supply is primarily diversification of gas suppliers. The EU has imported nearly 64% of its gas demand and this figure will increase to 80% by 2020, making the Union the world's largest gas importer by 2030. This involves nearly 100% increase in gas use in Western Europe and 150% rise in its use in the east of the continent by 2025 from estimated figures for 1995, and more than three times the period of 1956–1995. The EU gas production in 2000 was close to 232 bcm, and this number reached to 175 bcm in 2010, equal to 5.5% global gas production, while Denmark and the Netherlands were the only gas exporting countries among the EU–27 and could be expected to remain so until the end of 2018 and 2020 respectively. In addition, the share of natural gas in some EU member states' energy mix is more than the Union average of 24%, e.g. the Netherlands (43%), Italy (41%), the UK (40%) and Spain (24%).

It is possible to perceive of different scenarios concerning the amount of natural gas and LNG demands within the EU in the future, based on the rise of the gas price, further advances in unconventional gas, etc., although, on the basis of the renewable energy sources growth within the EU in the future two scenarios could be considered:

- Scenario 1: Strong growth in gas demand or base case demand;
- Scenario 2: Limited growth or Low demand.

LNG has become more popular and has the capability of changing the regional gas markets to a more globalised one. Hence, LNG capacity will increase from 270–296 bcm in 2008 to 450 bcm in 2015 and 540–566 bcm in 2020. The LNG trade has not only grown in volume, but geographically expanded from 13 exporters in 2005 to 18 in 2010, however roughly 80% of global LNG is transmitted by the 8 top exporters. It is expected that the capacity of global LNG trading will double by 2020 and more by 2030. According to a number of projections, more than 50% of all interregional gas trading will be by LNG carriers by 2030, and its trading will be close to 200% by 2020.

The number of importers from 2005 to 2010 grew by around 200% to 22; only the US decreased its LNG imports during 2005 to 2010 due to the domestic supply from unconventional gas. This country will be the second global gas producer during the next decade(s), however, the country will still remain the main LNG consumer with nearly half of the global demand, so its gas production from unconventional and conventional gases will mostly be consumed domestically.

It is worth mentioning that 80% of global LNG imports, belonged to the top 10 importers, while Spain, the UK, France and Italy, as the 3th, 4th,5th, and 10th of global LNG importers respectively imported 25% of the world's LNG supply.

Pipelines are expected to remain the most dominant means of gas transport towards the EU in the future, although LNG will account for nearly one–fourth of European total natural gas needs by 2020, compared to 15% in 2010, and, due to growing demands and decline of continental gas production, from 51% in 2010 with nearly 280 bcm/y to 33% with approximately 222 bcm/y by the end of the current decade, LNG share will be doubled from 85 bcm/y to around 170 bcm/y during the same period.

Apart from the current 17 on–stream regasification terminals, there are 14 under construction and proposed LNG facilities, except cancelled and suspended ones, within the EU, 24 of which are situated in Spain, the UK, France and Italy, close to 80%, so that nearly 87% of the required LNG is imported by these countries. Moreover, the rate of the EU's LNG imports will rise close to 90% in 2020, compared to 2010 and this percentage will increase further by 2030. The EU's member states referred to above are much more important in the future not only for the Union, but also for the whole of Europe, while for the time being, there are just two online terminals operating in Turkey and three proposed terminals exist in Croatia and Albania.

Russia, Norway and Algeria represent together 85% of the EU's gas imports and the rest comes from Algeria, Qatar, Libya, Egypt, Nigeria and other exporters. In addition, this region has been attracting around 33% of the Qatari LNG, as the leading supplier worldwide, in recent years.

Diversification of LNG suppliers has also been at the top of the EU statements, particularly since the early 2000s.

The Middle East, with a high potential for more exports to the EU in the future, holds 40% of global gas reserves, approximately all of which are situated in the Persian Gulf, as the gas richest area worldwide with its exclusive features economically, politically, strategically, geo–politically, etc. and six of its countries out of eight, are within the top 20 gas holders worldwide, while there is the likelihood that some more natural gas reserves would be discovered in the future within the Persian Gulf region. The discovery of natural gas in Iran, for example, in 2011–2012, compared to one year before that, has had the highest percentage all over the world. However, most of the proven natural gas reserves in the region, with the exception of those found in Iran and Qatar, are in associated form together with oil. Iran and Qatar embrace nearly 30% of global or 75% of the Middle East's gas reserves and more than 55% of the Middle East/Persian Gulf's gas production belongs to these two countries.

While the Persian Gulf has the highest natural gas reserves worldwide, it only accounts for around 12% of global production as it faces a number of internal and external challenges in order to increase its gas exports in the future, such as unconventional gas produced by the US, rise of LNG export by Australia, high indigenous gas demands, regional political volatility, inadequate international investment, energy inefficiency and dependence on hydrocarbon consumption, as well as governmental rules restricting foreign investment and participation in some regional states.

It is obvious that the Persian Gulf states should remove these obstacles locally with collaboration with each other and also internationally with the partnership of influential players. This trend could accelerate the emergence or expansion of regional gas plans and help security of supply.

"Regional Security Complex Theory" is able to explain the effects of natural gas and LNG exports from the Persian Gulf to the EU on both regions' energy security, as indicated in the hypothesis. This theory also serves to connect the Persian Gulf's subordinate system and the EU's new regionalism theories to each other. The sectors of security in the Regional Security Complex Theory are military, political, economic, societal and environmental security and these five criteria have definitely impacted on regional security.

While energy has been a "matter of security", it could be added as the 6^{th} factor affecting security. Therefore, the term of energy security could enter the Regional Security Complex Theory literature.

This theory consists of four main concepts, comprising: maintenance of the status quo, internal transformation within the current boundaries of the complex, external transformation, as well as overlay, which, in military security means military presence in any weaker state(s).

Considering the above–mentioned concepts, the structure of the EU's energy security based on the current regional energy policy regarding natural gas and LNG could be complex and redefined, as follows:

- ✓ Status quo: the EU has pursued more diversification of natural gas and LNG suppliers, routes and resources apart from the current exporters to the Union, so it does not support the status quo in its gas policy;

- ✓ Internal transformation: LNG projects, like the liquefaction facilities within the EU show that the Union seeks to alter the present situations and import more LNG in the future;
- ✓ External transformation: This stage can occur as a result of the new routes bringing additional LNG to the complex from ultra–regional suppliers, such as the Persian Gulf and leads to change the energy dependency patterns and link new states to the complex;
- ✓ Overlay: It could be viewed as massive reliance on a special gas supplier; however, owing to the high degree of securitisation of its energy dependence, the EU has followed this policy to expand its gas suppliers away from Russia.

On the basis of the current EU's energy policy, the Union plans to increase its natural gasand LNG imports in the future and the number of existing LNG facilities; together with those under construction and under consideration verifies this point (Internal transformation). The Union, moreover, is dissatisfied with huge dependency on Russian gas during recent years and diversification of gas suppliers is amongst the vital EU energy trinity (Overlay). These situations show that the EU is seeking to change the status quo in its energy needs, in general, and natural gas, in particular.

Besides, a number of LNG projects are in progress in some gas suppliers and the EU is one of the most important destinations of these actual and potential exporters in the future (External transformation).

In addition to some gas holders within the Persian Gulf, some other actual and potential LNG suppliers could send their product to the EU in the future, but it is less clear as to which of these exporters could be on the top and more influential on the Union's energy security, on the basis of the energy securityfour main indicators.

The classification scheme of the mentioned energy security indicators is the cornerstone for testing them on the EU's LNG relationships with different actual and potential suppliers, such as the Persian Gulf and then comparing them for ranking to clarify the most appropriate suppliers in the future for the Union.

For the acceptability and the percentage of methane of LNG in various suppliers, Russian gas is the foremost, followed by Egypt and Trinidad and Tobago and the percentage of LNG cleanliness in other global suppliers is at a relatively similar level.

Regarding the availability criteria, the volume of natural gas reserves in each supplier and the size of gas field(s) are important. The final results show that the Persian Gulf has the richest gas reserves worldwide, while Russian is the foremost nationally, followed by Iran and Qatar. The size of the natural gas fields is another factor both in the availability and affordability indicators. The Persian Gulf holds the widest gas reserves in the world, primarily by Iran. Russian reserves, in terms of extent, are placed in second position, followed by Qatar. Furthermore, the share of some current main gas suppliers, such as Algeria, Kazakhstan, Malaysia, Brunei, Norway (to some extent), and Trinidad and Tobago will decrease by the 2020s.

The cost of production is the first criteria of affordability, as the third indicator for the energy security. The lowest cost–to–production belongs to the Persian Gulf, including Iran, Qatar, and the United Arab Emirates. Russian reserves, Caspian Sea and North African gas holders are situated in the second global position in this regard. Supply cost is the second part of the affordability indicator and it is divided into liquefaction, transportation and regasification sections. In terms of liquefaction, Qatar, Iran, and Russian, excluding gas reserves within the Russian Barents Sea, are leading, followed by Algeria, Trinidad and Tobago, as well as Indonesia in some reserves and facilities. The last dimension of affordability, apart from regasification, is supply and transport costs, while the most proper LNG transportation prices relate to North African suppliers, particularly Libya, the Persian Gulf, West African, South American and Asia–Pacific suppliers place as the least–cheap shipping cost toward the EU. In terms of cost–to–production three of the gas holders within the Persian Gulf are at the top, followed by Russia, Caspian Sea and North African countries. The best price for liquefaction is in Qatar and Iran within the Persian Gulf, as well as Russia. Nonetheless, actual and potential LNG suppliers from the Persian Gulf, alongside other exporters, except North African ones, are amongst the suppliers towards the EU with the most expensive shipping cost. The cost of Norwegian supply gas in the 2020s would also be high due to need for new investments in the expensive gas fields.

Accessibility is the fourth indicator of the energy security with three criteria, consisting of the number of sea checkpoint(s), International Country Risk Guide/Composite Political, Financial, Economic Risk Rating, and the power of organization. On the subject of the sea checkpoint(s), North African and American suppliers, alongside Norway, have the least number in their LNG shipping routes toward the EU, whereas the Persian Gulf suppliers should send their vessels through three major checkpoints. Regarding the International Country Risk Guide/Composite Political, Financial, Economic Risk Rating, Norway and Arab Sheikdoms within the Persian Gulf enjoy the best situation for investment globally, followed by Russia, some Caspian littoral states, Algeria, Trinidad and Tobago, as well as Asia–Pacific, except Indonesia. The highest risk investment belongs to Venezuela and Egypt, while Iran is situated in the middle of this ranking with moderate risk investment. It demonstrates that, the periphery states, including Iran and, remarkably, Iraq have the highest risk investment among other gas holders within the Persian Gulf and Tehran should further try to improve its domestic conditions.

The membership of the Sheikdoms in the GCC has promoted the position of these gas holders in negotiation and partnership with the EU, while Iran's membership in other organizations, such as ECO was of limited help. However, Western and Asia–Pacific gas holders, in addition to Russia, have the highest positions in terms of membership in high–ranking regional organizations, followed by North African states.

Global gas consumption will dramatically increase by almost 50% more than the current level by 2030, so in order to meet this demand, the world's gas producers, specially non–OECD countries, need to increase their supplies and some new gas exporters must be added in order to fill the demand–supply gap.

Russia, the US, Iran, Qatar, Algeria, Norway, Nigeria, and Australia will be amongst the top 10 natural gas and LNG producers by 2030. Moscow, as the existing EU's largest supplier, will most likely strengthen its position and Algerian LNG is predicted to be still foremost and more competitive than other Mediterranean LNG suppliers to the Union by 2030. In addition to Russia and Algeria, other suppliers, comprising Qatar, Iran, Australia, Indonesia, and Saudi Arabia are expected to be the leading global LNG exporters by the end of the next decade, followed by the United Arab Emirates, Venezuela and Nigeria.

Apart from Norway, gas production in OECD Europe has been in decline, while it will probably transport its gas to the continent by pipeline. South American gas suppliers will play the least important role in the global gas market in the future and this region will be probably neither a gas importer nor exporter, just involved intra–regional gas trading.

Unlike Australia, some of the natural gas exporters within the ASEAN, such as Malaysia and Brunei, will be amongst the major exporters by 2025 and after that they will probably convert in to importers. Indonesia, moreover, will face declining production from many older gas fields and must make more investments to new fields or its unconventional gas reserves.

According to some predictions by some major energy bodies, such as IGU, BP, IEA, and the Baker Institute (annex 2), Qatar, Iran and Australia will hold around 50% of global LNG exports by 2040, while the first two countries could play an important role to connect regional gas markets with each other to emerge on the global gas trading system.

The European Commission in different meetings and statements, such as the Green Paper on energy security in March 2006, concluded that, "Europe has entered in to a new energy era with increasing dependence on natural gas imports from unstable regions. So, both economic (geographical proximity, technology, low prices), as well as political criteria (cooperation or conflict with friendly and unfriendly or less–friendly states) are important for the EU to choose its future LNG suppliers, while the ellipse between the Mediterranean Sea to the Hindu Kush mountain range is the full of gas reserves, but the biggest conflicts and disputes happen in this huge area.

The more the market is open, the better the energy security situation happens to be, so, if new LNG suppliers enter the EU's gas market, this would impact on the current suppliers' market power and shares. The reasonable choice is that the main importers should not invest in and trust the minor gas holders in the mid and long–terms, therefore the best options would be the low–cost huge gas holders with lower risks.

Qatar is the best option in this respect, followed by Russia, Algeria, Saudi Arabia, Australia (apart from its long distance) and then Iran. However, some suppliers are suitable for short and mid–terms, like Trinidad and Tobago.

Based on "Qatar's National Vision 2030 Document" with four interconnected pillars, simultaneous with the implementation of "Qatar National Development Strategy 2011–2016", the wise management, long-term maintenance of the strategic hydrocarbon reserves alongside balance between deposits and production are in accordance with this country's interests.

Qatar's economic and social growth have accelerated, leading to an increase of domestic demand that has more than doubled since 2000 and turned this state into the 4th largest gas consumer in the Middle East/Persian Gulf. It is expected that the internal NG consumption will increase even faster in the future.

Doha's LNG exports have more than doubled between 2008 and 2011 and converted this country to the 1st–placed exporter worldwide. It has supplied nearly 33% of its product to the EU, including the UK, Belgium, France, Greece, and Portugal.

Consequently, there two main arguments regarding the future of Qatar's LNG supply that take effect on this state's energy security in the future. The first insists on the preservation of the current supply, while some Qatari officials have emphasised that this country's leadership in the global LNG supply should be maintained in the forthcoming years.

Iran, is the Middle East and Persian Gulf's largest gas producer, situated at the centre of the "Energy Ellipse", as the only bridge between the Middle East and the Persian Gulf in the south and Central Asia/Caspian Sea in the north, with over half of the world's known hydrocarbon reserves. Its reserves are predominantly located off–shore, more than 68%, and more than 85% of these reserves are non–associated gas. It has two main Grand Energy Strategy and Outlook Documents, as well as ambitious targets by 2023 in raising its current 1% share in the global gas market to 8%–10% by 2023 and taking part in GECF more actively, while this country alongside Russia and Qatar, as the top three global gas holders and this organization's members, account for about 54% of the global natural gas deposits.

In addition, the GEFC, despite its internal and external challenges on its way to becoming more powerful, is reportedly shifting towards LNG, as the members provide 85% of the world's LNG exports. Iran has a number of plans to construct and develop its LNG projects to connect itself to regional and global gas markets, particularly the EU and Asian, increase its share in this market, and be more active in GEFC, as "without LNG industry, Iran is not powerful enough".

So, these LNG projects could assist Iran in achieving its targets and put this country among the top five global exporters by 2020, while, on the other hand, this trend could definitely impact on Tehran's energy security in the future, providing that Tehran is able to attract the required investment and technology from abroad, implement time management plans to participate in the international LNG chain, as well as modernisation of its industry.

However, foreign sanctions in addition to high domestic consumption are the main impediments against these objectives and three main scenarios regarding these two principal hurdles against Iran's pipeline and LNG projects and export could be conceived.

If Iran decides to achieve its gas targets by the early 2020s, it should construct and develop its LNG industry with the main destinations, including the EU and Asia. The major impediment for this country would be accessibility, regarding the International Country Risk Guide/Composite Political, Financial, Economic Risk Rating and regional institutionalism. Accordingly, if Tehran could solve its problem(s) regarding the accessibility of LNG for other importers, its position would dramatically improve in the global ranking, even better than Qatar. So, engagement with the EU in LNG trade could diversify Iran's export routes, leading to intensify its energy security and increase its share in the global gas market.

Regarding the International Country Risk Guide/Composite Political, Financial, Economic Risk Rating, the local situation is more important than the regional and international situations, as all the Arab Sheikdoms within the Persian Gulf have improved their conditions and converted to very low–risk countries, despite regional volatilities. So, Tehran must improve its International Country Risk Guide/Composite Political, Financial, Economic Risk Rating by different ways more domestically, such as more political stability and domestic reconciliation, as well as governmental rules, otherwise it might miss short–and mid–term benefits of LNG and gas markets.

The role of the government in developing of gas markets will strongly transform from direct investor and constructor of infrastructures to the facilitation of markets so that the main companies and investors, mostly private ones, will face reduced major risks.

Regarding the second point, it is important to indicate that despite some internal disagreements amongst the GCC members, like fears of Saudi hegemony on the smaller member–states, there is no unified "Gulf perspective" within the Council regarding some regional issues, such as the Iranian nuclear issue.

It seems that most of the mentioned dilemma in the "politicised Gulf" is partly related to separation of the centre and the periphery players, so the systematic coherence, interdependence, and vital belief to regional cooperation has not been observed.

The Persian Gulf, as the sub–system of the Middle East, is politically in turmoil and economically stagnant mostly within the periphery, so the regional arrangements are fragile and security interdependence amongst various regional and ultra–regional players is insufficient.

This region consists of the GCC, Iraq, as a non–GCC Arab country and non–Arab Iran, as well as some ultra–regional players, such as the US, the UK, and France.

In accordance with the "subordinate system theory", the core or centre sector, the peripheral section and the intrusive player(s) counted as the main regional players. This system consists of a score of adjacent and interacting states which have some common ethnic, linguistic, cultural, social, religious, and historical bonds, or at least have geographical proximity. However, the diplomatic orientation of some of these states, like the GCC, is sometimes toward the ultra–regional player(s), particularly the US.

The states within the GCC, as the core sector, have shared social, political, economic, religious or organizational backgrounds. The peripheral sector, including Iran and Iraq, is separated from the core sector to some degree by economic, organizational, social, religious or political factors, but plays a role in the politics of the subordinate system. In addition, the relationships between the core and periphery are crucial.

As a result, the core and periphery sections within the Persian Gulf have been competitors and a balance of power system, based on mistrust and zero–sum game (lose–lose), has dominated the regional political atmosphere, leading to securitise energy, while the periphery members (especially those which are isolated) often attempt to manipulate the security objectives of the intrusive powers.

The intrusive player(s) consist(s) of the external power(s) participating in the region politically, militarily, etc. The US is the major power of intervention in the Persian Gulf, while some other ultra–regional states, such as France and the UK, have participated in regional order and policies. The power of intervention, moreover, has politically significant involvement in the regional balance of power and affects the politics of the core and periphery parties, as well as the regional affairs.

This theory is consistent with the Persian Gulf region's characteristics and could illuminate the current regional context in order to find a proper solution for more stability in this area. It is obvious that this situation could help transport energy, in general, and LNG, in particular, to other consumers more safely.

They have not been able to restore mutual trust, mostly due to two factors: the US' policy of containing Iran's and Tehran's nuclear stalemate and regional disputes. These two factors drive the Sheikdoms to continue relying on outsiders.

First of all, the GCC as a core needs to find a practical balance between dependence on the US, as an external security guarantor (Davidson, 2012: 169 & 170), and the creation of a regional comprehensive and cooperative security system, like the Organization for Security and Cooperation in Europe, that can provide greater stability than the balance of power system has done by engaging with Iran and also post–occupation Iraq as peripheral states in the region that could be entitled as the "GCC+2".

In the second stage, Iran should solve its nuclear issue via negotiation, bargaining and more confidence–building and its counterparts could help resolve it, but this needs to be a mutual trend.

Nonetheless, the interests of all countries in the region should be based on finding realistic solutions by creating and extending political and economic bridges and the GCC, particularly, due to geographical proximity, along with the EU should try to serve as an intermediary, between Washington and Tehran over some regional and international conflicts, such as nuclear disputes, as is clear in negotiations between Tehran and 5+1[20].

As a result, within the framework of this space, such as during the 1990s, Iran and the GCC could talk about confidence–building, mutual defense pacts, and cooperation over regional security matters in order to create "Gulfisation of security", on the basis of "the core– periphery relations" (Davidson, 2012: 169 & 170). In this case, the balance of interests and security amongst the core and peripheral states, as well as intrusive player(s) would be emerged.

It should primarily concentrate on commonalities, rather than differences, and could be commenced from economic needs, such as energy, and then extend to comparative cooperation, such as creation of a regional common market, extension of gas pipelines, and establishment of joint shipping lines. So, it could help to reduce the security dilemma based on non–zero sum (win–win) game and détente even with foreign powers, such as happened from the mid–1990s until the mid–2000s.

If the ultra–regional players, especially the US accept an Iranian role in the region's new security architecture, Washington and Tehran could consequently establish an accommodation that might advance the interests of all parties, both regional and trans–regional actors in the Persian Gulf. Furthermore, the US will produce additional oil and gas from unconventional resources in the future; being more independence from the Persian Gulf's hydrocarbons and this trend could impact on Washington's policy with regard to the region, according to Christopher Davidson on 27th November 2012.

On the other hand, the interaction between the mentioned players could lead to political, economic and security stability, in particular in hydrocarbon exports from the Persian Gulf region to other areas, such as the EU.

[20] The 5+1 consists of five permanent members of the United Nation Security Council, including China, France, Russia, the UK and, the US plus non–memberGermany.

As a result, balance of interests and security amongst the core, periphery states and also intrusive players, instead of balance of power, can ensure the global and regional security of LNG supply in the future.

The EU, on the other side, consists of 27 independent countries, but has long presented itself to the world as the most developed model of regional integration.

Regionalism has been observed as a multidimensional integration ranging from economic, cultural, political, social specifications to security aspects with various states, non–state players. Nevertheless, after nearly three decades and since the end of the bipolar Cold War, regionalism entered the new phase in a multipolar world order and new regionalism was basically formed, particularly in the EU.

The energy policies in the EU, especially the Energy Policy, are implemented regionally with the three main cornerstones of competitive internal energy market, sustainability and security of supply. Nonetheless, the main regional institutions and policy–makers have struggled to promote energy solidarity within the Union and decline any single voice by the member states individually.

As investigated previously, security of LNG supply is one the EU's energy targets in the future. Spain, the UK, France and Italy, as the main LNG importers not only in Europe but also in the world, have already imported of nearly 87% of the required LNG in the EU, while close to 80% of the existing on–stream regasification facilities together with the future terminals, comprising the under construction and under consideration ones, are situated in these countries.

Obviously, these EU member states are more significant for the whole of Europe in the future. As a result, energy decision–making within the Union is more regionally and on this basis, the security of LNG supply has been scrutinized in the framework of the new regionalism theory to analyse the energy security of the EU in years and even the decades to come.

In conclusion, pursuit of diversified LNG suppliers and routes of supply, as well as more investments in the main gas holders' LNG facilities could play significant roles to minimise risks and vulnerabilities for the EU in the mid and long terms. With ever–changing international relations, security of supply becomes more imperative and some of the low–risk suppliers might be able to charge a higher price if not only the EU market, but also other regions and countries consider just the risk–premium to gas from certain sources in the world with its growing demands.

When gas corridors are key for security of supply but hindered by political uncertainty, the EU can play an important role to remove this obstacle or make it easier to be resolved. It could be based on interests of all the involved parties, by further dialogue, such as "critical dialogue", followed by "comprehensive or constructive dialogue" as happened with Iran in the 1990s and energy diplomacy, such as the creation of a working group on energy established in May 1999 by the European Commission and Iran, as the EU's 6th largest energy supplier to the Union before the oil sanction in June 2012. Further participation of the EU in INOGATE, as well as mutual negotiations for TCA (Trade and Cooperation Agreement) in June 2002 could be two more instances.

Creation of "a prosperity, stability and security belt" in the EU's surroundings, based on common values (Schweiger, 2012), like the "Barcelona Process" could definitely increase the Union's interests, while energy is the main linkage between the Persian Gulf states and the EU.

Nevertheless, the reform, respect of human rights and fundamental freedoms have been priorities for the EU in order to develop its relations with other counterparts, according to the Head of Electricity and Gas Unit, Directorate–General for Energy and Transport for theEuropean Commission (interview, Op. cit.).

While the EU proclaimed its support for governance reforms and transparency, more democracy, as well as human rights in oil and gas producers as an approach to its energy security, but "it was highly inconsistent on this issue and energy and democracy–related decisions were disconnected from each other … and also the quality of democratic process in these countries played no determinant role in investment decisions at the EU level" by the International Oil Companies (Young, 2009: 5–6).

As an example, The Extractive Industries Transparency Initiative (EITI) was signed by a few EU member–states, however was not already Europeanised. While the Commission has called this plan as a good initiative, but it declined to support the EITI and most European governments have blocked proposals to exert strong and united regional pressure on main energy producers in Africa, the Caspian and the Persian Gulf regions. For this reason, the EITI currently includes states with 5 to 10 per cent of world oil and gas production (Young, 2009: 47).

So, these policies could be pursued with other countries, mutually, such as the National Indicative Programme 2007–2013 in Libya, in parallel with other issues, such as energy negotiations.

Natural gas, like oil, is a "political commodity", so any decision regarding the production, price, trade, and investment in any producers, like the Persian Gulf, has been made on the basis of political and strategic considerations, rather than "supply and demand equilibrium".

Notwithstanding, the Persian Gulf is an "unstructured region", but it could be named as the "regional grouping" and the Regional Security Complex Theory enables to connect this "micro region" to the EU, as the "macro region".

The Regional Security Complex Theory consists of five main sectors of military, political, economic, societal and environmental security. While the energy policy has been securitised, energy could be embedded as the sixth element, the so–called energy security. As a result, the EU and the Persian Gulf would be more active under the Regional Energy Security Complexes by mutual energy interaction and interdependence of energy security.

It is important to mention that security of one state or region cannot be easily separated from the security of another, for this reason, the importance of the security interdependence could be highlighted. Therefore, any development in

LNG supply from the actual and potential suppliers in the Persian Gulf to the EU could affect the energy security of the both regions in the future (figure 2).

On this basis, the four criteria of the Regional Security Complex Theory are redefined in the Regional Energy Security Complexes. The EU is supposed to escalate its LNG imports in the future and the number of the current LNG facilities, together with those under construction and under consideration, mainly in the four case studies, demonstrates the "internal transformation" in the energy area of the EU.

Likewise, the Union becomes dissatisfied with huge reliance on Russian gas, hence diversification of LNG suppliers in the future at the same time with the regional growth in LNG demand would definitely change the status of quo in gas supply within the EU.

On the other hand, some LNG projects are in progress in a number of the current and future overseas suppliers and this Union would be amongst their destinations. Therefore, the Union's external LNG situation will be undoubtedly transformed.

It is recommended that strategic partnerships be developed between the EU and the major gas supply and transit countries, such as extending the "EU–Russia dialogue", the "Neighborhood Policy" with the Caspian Sea littoral states, the "Baku Initiative", based on the EU's energy policy paper in January 2007. Energy concerns have been an important element behind the EU's new Strategic Partnership with main gas and LNG producers (Young, 2009: 64). For this reason, the "EU–[GCC+2] Partnership", as the win–win game, in accordance with the interdependence of the energy security sounds perfect.

Bibliography

- _______ (2008) "Qatar National Vision 2030", General Secretariat For Development Planning, July.

- _______ (1390/ 2011) *Mashal (flame in English) Journal*–Iran's Petroleum Ministry Weekly, Tehran, No: 537, 21st Farvardin/ 10th April.

- _______ (1390/ 2011) *MashalJournal*–Iran's Petroleum Ministry Weekly, Tehran, No: 544, 8th Khordad/ 29th May.

- ________ (1390/ 2011) *Mashal–Iran's Petroleum Ministry Weekly*, Tehran, No: 546, 22nd Khordad/ 12th June.

- ________ (2007) "West Adds to Strains on Iran's Lifeline," *the New York Times*, 13th February.

- Aad Correlje´ and Coby van der Lindeb,c (2006), "Energy supply security and geopolitics: A European perspective",*Energy Policy* (34): 532–543.

- Aarts, P. and Duijne, J (2009) "Saudi Arabia after U.S.-Iranian Détente", *Middle East Policy*, Vol. XVI, No.3, Fall.

- Abi–Aad, N. (2009) "Energy in the Mediterranean and the Gulf Opportunities for Synergies", Document IAI, December, Istituto Affari Internazionali, Rome, Italy.

- Akhlaghi, R. (2009) "Iran: Geopolitical Conundrum", Toronto–Canada, [online], http://globalbrief.ca/blog/2009/12/08/iran-geopolitical-conundrum, (Accessed 8th December 2010).

- Alhajji, Anas F. (2007c) "What Is Energy Security? Definitions And Concepts" (Part 4/5), *Middle East Economic Survey*.

- Alhajji, Anas F. (2007d) "What Is Energy Security? Definitions And Concepts" (Part 5/5), *Middle East Economic Survey*, [online], http://www.mees.com/ postedarticles/oped/v51n02-5OD01.htm, (Accessed at: 11th October 2009)

- Almasi, R. (1390/2011) *Mashal–Iran's Petroleum Ministry Weekly*, Tehran, No: 549, 12th Tir/ 3rd July.

- Al–Munajjed, A. (2009) "GCC–EU relations at the turn of the century", 13th December, Institute for International and Strategic Relations (IRIS), Paris, France.

- Armitage, R. and Nye, J. (2007) "CSIC Commission on Smart Power", Center for Strategic and International Studies (CSIS).

- Asia Pacific Energy Research Centre–APERC (2007) "A quest for Energy Security in the 21st century", Institute of energy economics, Japan, [online], www.ieej.or.jp/aperc.

- Asclepias, I., Fauz, D.A and Firdaus, A. (2011) "The sustainable development deimension of energy security", pp. 96–113, in K. Sovacool, Benjamine (eds), *The Routledge Handbook of Energy Security*, Oxon and New York, the USA: Routledge.

- Bahgat, G. (2010) "Iran's Role in Europe's Energy Security: An Assessment", *Iranian Studies*, 20th May, 43 (3): 333–347.

- Bahgat, G. (2011) *Energy Security: An Interdisciplinary Approach*, West Sussex, the UK: John Wiley and sons Ltd.

- Barzegar, K. (2010) "Balance of Power in the Persian Gulf: An Iranian View", *Middle East Policy*, Vol. XVII, No. 3.

- Barzegar, K. (2011) "Atom for Sustainable Development and Prestige," Centre for Middle East Strategic Studies [online], http://fa.merc.ir, (Accessed 28th August 2011).

- Bauer, M., Koch, C. and Hanelt,C. (2010) "The EU–GCC Partnership: Security and Policy Challenges", 1st May, Al–Jisr Project on EU–GCC Public Diplomacy and Outreach in Center for Applied Policy Research, Gulf Research Centre, *GRC Policy Brief*, Dubai, the UEA.

- Bauer, M. (2011) "The need for an EU–Gulf Strategy in the wake Of the Arab spring", 16th May, Center for Applied Policy Research (C·A·P), University of Munich, Germany [online], http://www.cap-lmu.de/aktuell/pressespiegel/2011/eu-gulf-strategy.php (Accessed 19th September 2011).

- Baumann, F. (2008) "Energy Security as a multidimensional concept", March, Research Group on European Affairs, Center for Applied Policy Research–CAP - Policy Analysis, No. 1.

- B.Charles, M., Ryan, R., Oloruntoba, R., von der Heidt, T. and Ryan, N. (2009) "The EU–Africa Energy Partnership: Towards a mutually beneficial renewable transport energy alliance?", *Energy Policy* (37): 5546 – 5556.

- Beeson, M. (2006) "American Hegemony and Regionalism: the Rise of East Asia and the End of the Asian–Pacific", *Geopolitics*, 11/4.

- Belkin, P. (2008) "The European Union's Energy Security Challenges", 30th January, Congressional Research Service (CRS Report ; RL33636), Washington, the USA, [online], http://www.fas.org/sgp/crs/row/RL33636.pdf.

- Belkin, P., Ratner, M., Nichol, J. and Woehrel, S. (2012) "Europe's Energy Security: Options and Challenges to Natural Gas Supply Diversification", 13rd March, Congressional Research Service (CRS Report; R42405), Washington, the USA.

- Berry, D. (2009) "Innovation and the price of wind energy in the US", *Energy Policy* (37): 4493–4499.

- Bert K., D.P.vanVuuren, H.J.M.deVries and H. Groenenberg (2009) "Indicators for energy security", *Energy Policy* (37): 2166–2181.

- Bertram, C. (2008) "For a New Iran Policy," *CER Bulletin*, April/ May, No. 59, Center for European Reform, London, the UK.

- Bidar Maghz, H. (1390/2011) *Mashal Journal–Iran's Petroleum Ministry Journal*, Tehran, No: 560, 17th Shahrivar/ 8th September.
- Bilgin, M. (2009) "Geopolitics of European natural gas demand: Supplies from Russia, Caspian and the Middle East", *Energy Policy*, 37(11).
- Birol, F. (2005) "Energy challenges for Europe to 2010 and beyond according to the IEA", *European Review of Energy Markets (EREM)*, Vol: 1, Issue: 1, September.
- Birol, F. (2007) "Energy Economics: A Place for Energy Poverty in the Agenda?" *The Energy Journal*, Vol 28, No 3, pp. 1–6
- Borenstein, S. (2012) *Associated Press*, 31st May.
- Bosmans, W. (2007) "A contribution to the current EU debate on energy–Focus on the European gas market", European Energy Institute and contributors (EREM), Vol: 4.
- Bosse, G. and Schmidt–Felzmann, A. (2011) "The Geopolitics of Energy Supply in the Wider Europe", *Geopolitics*, 16 (3): 479–485.
- British Petroleum–BP (2008) "Statistical Review of World Energy", June, London, the United Kingdom.
- British Petroleum–BP (2009) "Statistical Review of World Energy", June, London, the United Kingdom.
- British Petroleum–BP (2010) "Statistical Review of World Energy", June, London, the United Kingdom.
- British Petroleum–BP (2011) "Statistical Review of World Energy", June, London, the United Kingdom.
- British Petroleum–BP (2011) "Energy Outlook 2030", January, London, the United Kingdom.
- British Petroleum–BP (2012) "Statistical Review of World Energy", June, London, the United Kingdom.

- British Petroleum–BP (2012) "Energy Outlook 2030", January, London, the United Kingdom.

- Broad, W. and Sanger, D. (2007) "With Eye on Iran, Rivals Also Want Nuclear Power", *The NewYork Times*, 15th April.

- Buchan, D. (2011) "Expanding the European dimension in energy policy: the Commission's latest initiatives", October, the Oxford Institute for Energy Studies, the United Kingdom.

- Burke, E. and Bazoobandi, S. (2010) "The Gulf Takes Charge: The GCC in the MENA Region", AWRAQ Institute [online], www.awraq.es/ blob.aspx?idx=6&nId =56 &hash (Accessed: 25th August 2012).

- Burnham, P., Gilland L., Grant, W. and Layton-Henry, Z. (2008) Research Methods in Politics, 2nd ed. New York, the USA: PALGRAVE MACMILLAN.

- Buzan, B. (1991) *People, States and Fear: An Agenda for International Security Studies in the Post-Cold War Era*, Second Edition, Hertfordshire: Harvester Wheatsheaf.

- Buzan, B., Waever, O. and de Wilde, J. (1998) *Security: A New Framework for Analysis*. Colorado: *Lynne Rienner Publishers, inc. Boulder*.

- Buzan, B. and Waever, O. (2003) *Regions and Powers: The Structure of International Security*, UK: Cambridge University Press.

- Cambridge Energy Research Associates_CERA (2006) "The New Energy Security Paradigm", Spring, the USA.

- Cantori, L.J. and Lospiegel, S. (1969) "International Regions: A Comparative Approach to Five Subordinate Systems", *International Studies Quarterly*, Volume 13, No: 4, December: 361–380.

- Cantori, L.J. and Lospiegel, S. (1970) *The International Politics of Regions: A Comparative Approach*, N.J. Prentice–Hall: Englewood Cliffs.

- Cantori, L. J. and Lospiegel, S. (1970b) "The International Relations of Regions", *Polity 2* (Summer).
- Catalano, A. (2011) "The EU–Energy–Turkey Triangle. Does energy really matter in Turkey's Accession Process?", GRIN, Germany.
- CEDIGAZ (2006) "Natural Gas in the World-Trends and Figures", France.
- CEDIGAZ (2010) "Indonesia: CBM Could Account for 15% of Gas Supply", *U–Gas News Report*, No: 50, October, France.
- CEDIGAZ (2011) "Natural Gas Year in Review: Cedigaz' First Estimates", April, France (access at: www.cedigaz.org/Fichiers/FEstimates 2010.pdf).
- CEDIGAZ, "Statistical Database," (access at: www.cedigaz.org/products_services/statistical_data.aspx).
- Centre for European Reform_CER (2011) "Green, Safe, Cheap, Where next for EU energy policy?", September.
- Chapman, D. and Khanna, N. (2006) "The Persian Gulf, Global Oil Resources, and International Security," *Contemporary Economic Policy* 24, No. 4.
- Checchi, A., Behrens, A. and Egenhofer, C. (2009) "Long–Term Energy Security Risks for Europe: A Sector–Specific Approach", January, CEPS.
- Cherp, A. and Jewell, J. (2011) "The three perspectives on energy security: intellectual history disciplinary roots and the potential for integration", *Current Opinion in Environmental Sustainability 2011,* No: 3, pp. 202-212.
- Chevalier J.M. (2006) "Security of energy supply for the European Union", European Review of Energy Markets (EREM), Vol: 1, issue: 3, November.
- C. Jansen, J. and Seebregts, A. (2010) "Long-term energy services security: What is it and how can it be measured and valued?",*Energy Policy*, No: 38, pp. 1654–1664.

- C. Jansen, Jaap and J. Van der Welle, Adriaan (2011) "The energy services dimension of energy security", pp. 239–250, in K. Sovacool, Benjamine (eds), *The Routledge Handbook of Energy Security*, , Oxon and New York: , the USA: Routledge.

- Clingendael International Energy Programme–CIEP (2008) "The gas supply outlook for Europe: The roles of pipeline gas and LNG", August, The Netherlands.

- Cohen, A. (2008) "Gas Exporting Countries Forum: The Russian-Iranian Gas Cartel", *Journal of Energy Security (IAGS)*, 14th December.

- Cohen, A. (2009) "Russia: The Flawed Energy Superpower", pp. 91–109, in Luft, Gal and Korin, Anne, *Energy Security Challenges for the 21st Century*, the US: Greenwood Publishing Group.

- Cole, D. (2010) "The United Kingdom's Energy Security Debate", *Journal of Energy Security (IAGS),* 23rd March.

- Cordsman, A. (2000) "The role of the Europe in the Middle East", Available from: www.eipa. doc.gov /oiaf /aeo/ results [accessed 30 Jan 2009].

- Cortinovis, N., Naldini, A. and Ninni, A (2011) "Expert evaluation network delivering policy analysis on the performance of cohesion policy, 2007–2013: Year 2011", final report to the European Commission Directorate–General Regional Policy, Italy.

- Costescu Badea, A. (2010) "Energy Security Indicators", Institute for Energy Security Unit of the Joint Research Centre within the European Commission, 19th–21st May, [online], http://www.jrc.ec.europa.eu/).

- Council of the European Union (2008) 'Report on the Implementation of the European Security Strategy, Providing Security in a Changing World', 11th December, Brussels.

- Cutler R. (1999) "Cooperative Energy Security in the Caspian Region: A New Paradigm for Sustainable Development?",*Global Governance*, No. 2, April–June: 251–271.

- D'Agostino, A. (2011) "The social development dimension of energy security", pp.205–218, in K. Sovacool, Benjamine, *The Routledge Handbook of Energy Security*, Oxon and New York, the USA: Routledge.

- Dargin, J. (2008) "*The Dolphin Project: The Development of a Gulf Gas Initiative*", January, Oxford Institute for Energy Studies.

- Davidson, C. (2010 a) "Persian Gulf–Pacific Asia linkages in the 21st century: A marriage of convenience?", January, Kuwait Programme on Development, Governance and Globalisation in the Gulf States, The Centre for the Study of Global Governance, No: 7.

- Davidson, C. (2010 b) *The Persian Gulf and Pacific Asia from Indifference to interdependence*, London, the United Kingdom: C. Hurst and Co. (Publisher) Ltd.

- Davidson, C. (2011a) *Power and Politics in the Persian Gulf Monarchies,* London, the United Kingdom: C. Hurst & Co. (Publisher) Ltd.

- Davidson, C. (2011 b) "The Gulf Arab States and Asia Pacific: Geo–Economics and Interdependency", pp.183–198, in Legrenzi, Matteo and Momani, Bessma (eds), *Shifting Geo-Economic Power of the Gulf*, London: Ashgate.

- Davidson, C. (2012) *After the Sheikhs, The Coming Collapse of the Gulf Monarchies,* London, the United Kingdom: C. Hurst & Co. (Publisher) Ltd.

- Davidson, C. (2012) "Four More Years: Obama's Second Term and the Challenges Ahead", A School of Government and International Affairs Workshop, Durham University, 27th November.D. D'haeseleer, W (2005) "The overall energy issue; a bird's eye view", *European Review of Energy Markets (EREM)*, Vol: 1, Iss: 1, September.

- Delcour, L. (2011) *Shaping the post- Soviet space? EU policies and approaches to region-building*, England: Ashgate Publishing Limited.

- Decision No 1364/2006/EC of the European Parliament and of the Council of 6 September 2006 laying down guidelines for trans–European energy networks and repealing Decision 96/391/EC and Decision No 1229/2003/EC.

- Directive 98/30/EC of the European Parliament and of the Council of 22 June 1998 concerning common rules for the internal market in natural gas. OJ L 204, 21.7.1998.

- Directive 98/30/EC of the European Parliament and of the Council of 22 June 1998 concerning common rules for internal market in natural gas amended by directive 2003/55/EC of 26 June 2003.

- Directive of the European Council of 26th April 2004/67/EC regarding "measures to safeguard security of natural gas supply".

- Dorsman, A., Westerman, W., Baha Karan, M., Arslan, O. and Arslan, Z. (2011) *Financial aspects in energy: a European perspective*, Springer.

- Economic Commentary (2011) APICORP Research, Vol: 6, No: 9–10, September–October.

- Ehteshami, A. (2003a) "Oil, arms procurement and security in the Persian gulf", *Asian Affairs*, 34:3.

- Ehteshami, A. (2003b) "Reform from Above: The Politics of Participation in the Oil Monarchies", *International Affairs*, Vol. 79.

- Ehteshami, A. (2009) "Iran's Regional Policies since the End of the Cold War", in Gheissari, A (eds) *Contemporary Iran Economy, Society, Politics*, the United Kingdom: Oxford University Press.

- Ehteshami, A.and Zweiri, M. (2011) *Iran under Ahmadinejad: When Crisis becomes a Pattern*, Ithaca Press, the UK, Berkshire.

- El–Hokayem, E. and Legrenzi, M. (2006) "The Arab Gulf States in the Shadow of the Iranian Nuclear Challenge", May, The Stimson Centre, Working Paper.
- Elkind, J. (2010) "Energy Security: Call for a Broader Agenda", in Pascual, C. and Elkind, J. (eds) *Energy Security: Economics, Politics, Strategies, and Implications,* Brookings Institute, Washington DC.
- Energy Information Administration–EIA (2007) "Country Analysis Briefs: Iran", October, Washington D.C, the USA.
- Energy Information Administration–EIA (2009b) "Oman: Country Analysis Briefs", Washington D.C, the USA.
- Energy Information Administration–EIA (2011) "International Energy Outlook", DOE/EIA-0484, September, Washington D.C, the USA.
- Energy Information Administration–EIA (2011) "Country Analysis Briefs: Qatar", January, EIA, Washington D.C, the USA.
- Energy Information Administration–EIA (2011) "Country Analysis Briefs: United Arab Emirates" January, Washington D.C, the USA.
- Energy Directorate–General for the European Commission (2011) "Final Report on Unconventional Gas in Europe", TREN/R1/350–2008 lot 1, 8th November, Prepared by the law firm Philippe & Partners.
- Escribano, G. (2011) "Market or geopolitics? The Europeanization of EU's energy corridors", *International Journal of Energy Sector Management*, Vol. 5, Issue: 1, pp.39–59.
- Escribano, G., Garcia–Verdugo, J. and Marin–Quemada, J.M. (2012) *Energy Security for the EU in the 21st Century: Markets, Geopolitics and Corridors*, New York, the USA: Routledge.
- Escribano, G. (2012) "Energy Security for the EU in the 21st Century: Markets, Geopolitics and Corridors" in Tisma, S., Boromisa, A.M. and

Kaselj, A. (eds) *Environmental Finance and Development,* London: Routledge.

- Eurogas (2010) "Natural gas demand and supply in long Term Outlook to 2030".
- European Commission (1995) "White Paper: An energy policy for the European Union", COM 682 final, Brussels.
- European Commission (2000) "Green Paper: Towards a European Strategy for the Security of Energy Supply", COM (2000)769 final, Brussels.
- European Commission (2000) "Energy Infrastructure and Security of Supply", Communication from the Commission to the European Parliament and the Council, COM (2000) 743 final, Brussels.
- European Commission (2002) "The Internal Market in Energy: Coordinated Measures on the Security of Energy Supply", COM (2002)488, Brussels.
- European Commission (2003) "On the Development of Energy Policy for the Enlarged European Union, its Neighbours and Partner Countries", 26th May Communication, COM (2003)262 final, Brussels.
- European Commission (2004) "The share of renewable energy, in accordance with Article 3 of Directive 2001/77/EC, evaluation of the effect of legislative instruments and other Community policies on the development of the contribution of renewable energy sources in the EU and proposals for concrete actions", COM(2004)366 final, Brussels.
- European Commission (2006b) "Action Plan for Energy Efficiency: Realising the Potential", Communication from the Commission, COM(2006) 545 final, Brussels.
- European Commission (2006c) "Green Paper: A European Strategy for Sustainable, Competitive and Secure Energy", 8th March, COM (2006)105 final, Brussels.

- European Commission (2006) "Annex to the Green Paper: A European Strategy for Sustainable, Competitive and Secure Energy – What is at stake?", 8th March Background Document, Commission Staff Working Document, COM (92206)105, Brussels.
- European Commission (2006c) "Nuclear Illustrative Programme", Communication from the Commission to the Council and the European Parliament, COM (2006) 844 final, Brussels.
- European Commission (2007) "The second Green Paper: An Energy Policy for Europe", COM (2007) 1 final, 10th January, Brussels.
- European Commission (2007a) "An energy policy for Europe", Communication from the Commission to the European Council and the European Parliament of 10th January, COM (2007)848 final, Brussels.
- European Commission (2007a) "Renewable Energy Road Map. Renewable Energies in the 21st Century: building a more sustainable future", Communication from the Commission to the Council and the European Parliament, COM (2007) 848 final, Brussels.
- European Commission (2007) "The Internal Energy Market: Foundation of the EU Energy Policy", DG TREN.
- European Council (2007) "20-20-20" targets by 2020", 8th and 9th March.
- European Commission (2007) "Energy corridors European Union and Neighbouring countries", EUR 22581 2007 Directorate–General for Research.
- European Commission (2007) "Decision of establishing the composition of the Gas Coordination Group", 7th November 2006/791/EC, Brussels.
- European Commission (2008a) "Trends to 2030: Update 2007", April, Brussels: DGTREN.

- European Commission (2008b) "Europe's Energy Position: Present and future", Market Observatory for Energy, Brussels: DGTREN.
- European Commission (2008d) "Green Paper: Towards a Secure, Sustainable and Competitive European Energy Network", 13th November, COM (2008) 782 final, Brussels.
- European Commission (2008e) "Second Strategic Energy Review: An EU Energy Security and Solidarity Action Plan", 13th October, COM (2008) 781 final, Brussels.
- European Commission (2008e) "Energy 2020: A strategy for competitive, sustainable and secure energy", COM (2010) 639, Brussels: DGTREN.
- European Commission (2010f) "Energy Infrastructure: Priorities for 2020 and Beyond–A Blueprint for an Integrated European Energy Network", 17th November, COM (2010) 677, Brussels, Brussels: DGTREN.
- European Commission (2010e) "Energy 2020: A strategy for competitive, sustainable and secure energy", 10th November, COM (2010)639, Brussels: DGTREN.
- European Commission (2011) "The EU Energy Policy: Engaging with partners beyond our Borders", 7th September.
- European Commission (2011) "setting up an information exchange mechanism with regard to intergovernmental agreements between Member States and third countries in the field of energy", 7th September, COM(2011)540 final–2011/0238 (COD), Brussels.
- European Commission (2011) "Energy Roadmap 2050", XXX COM(2011) 885/2, Brussels.
- European Commission working Paper (2011), "Key facts and figures on the external dimension of the EU energy policy", SEC (2011) 1022 final, Brussels, 7th September.

- European Commission (2011) "the EU Energy Policy: Engaging with Partners beyond Our Borders", COM (2011) 539 final, Brussels.

- European Commission (2011) "Qatar Country File", December, [online], ec.europa.eu/ energy/observatory/doc/country/2011_12_qatar.pdf.

- Eurostat Statistical Book (2009) "Panorama of energy–Energy statistics to support EU policies and solutions", ISSN 1831–3256, Office for Official Publications of the European Communities, Luxembourg.

- E. Wiegand, K. (2012) "Bahrain, Qatar, and the Hawar Islands: Resolution of a Gulf Territorial Dispute", *Middle East Journal*, Volume 66, No. 1, winter.

- Faas, H., Gracceva, F., Fulli, Gianluca and Masera, M. (2011) "European Security–A European Perspective", pp. 9–23, in Gheorghe, Adrian and Muresan, Liviu (eds) *Energy Security: International and Local Issues, Theoretical Perspectives and critical energy infrastructure*, The Netherlands: Springer Science.

- Farrel, M., Hottne, B.and Langenhove, L. (2005) *Global Politics of Regionalism, Theory and Practice*, London: Pluto Press.

- Fattouh, B. (2007) "How Secure Are Middle East Oil Supplies", September, Oxford Institute for Energy Studies, the United Kingdom.

- Fawcett, L. and Hurrell, A. (2004) *Regionalism in World Politics*, UK: Oxford University Press.

- Fesharaki, F. (2007) "Energy and Security Issues: Perspectives on Iran, India, and China", July 12.

- Florini, A. (2010) "Global Governance and Energy", in Pascual, C. and Elkind, J. (eds) *Energy Security: Economics, Politics, Strategies, and Implications,* Brookings Institute, Washington DC.

- Frankfort, C.and Nachmias, D. (2008) *Research Methods in Social Sciences*, 7th edition, New York, the USA: Worth Publisher.

- Fredrik Palm, T. (2007) "The future of LNG in Europe and the potential impact on the market power of the gas suppliers", Norwegian School of Economics and Business Administration, Oslo, May.

- Friedemann, M. (2003) "Why Iran Is Key for Europe's Security of Energy Supply?", in: Iran and Its Neighbours: Diverging Vies on a Strategic Region, SWP, Berlin, Germany.

- Fürtig, H. (2007) "Conflict and Cooperation in the Persian Gulf: The Interregional Order and U.S. Policy," *The Middle East Journal*, Vol. 61, No. 4.

- *Gas Exporters Seek 'High' Prices as They Cooperate on Supply Projects* (2011) Bloomberg, 15th Nov.

- Gault, J. (2004a) "Oil, Gas and Energy Law Intelligence", available from:http://www.gcsp.ch/e/publications/SecurityChallenges/EnergySecurity/ Academic_ Papers/Gault_Gas.pdf [accessed 03 Feb 2009].

- Gault, J. (2004b) "Energy as a Security Challenge for the EU", *the Middle East Economic Survey*, 15th November.

- Gault, J. (2004) "European Natural Gas Network Security: A Holistic Approach", *OGEL (Oil, Gas and Energy Law Intelligence)*, Vol. 2, No. 1, February.

- Gause, G. (2005) "The International Politics of the Gulf", in Fawcett, L. (eds), *International Relations of the Middle East*, the United Kingdon: Oxford University Press.

- G. Bell, R. (2009) "NATO's Grapple with Energy Security", pp. 261–271, in Luft, Gal and Anne Korin (eds) *Energy Security Challenges for the 21st Century*, the USA: Greenwood Publishing Group.

- GEA Writing Team (2012) *Global Energy Assessment–Toward a Sustainable Future*, the UK: Cambridge University Press.
- Global Legal Group_GLG (2011) "The International Comparative Legal Guide to: Gas Regulation 2011", access at: www.ICLG.co.uk.
- Griot, A. (2010) "Innovation and Energy in France", 14th October, The Ministry of Ecology, Energy, Sustainable Development and the Sea (MEEDDM),
- Groot, K. (2010) "The Geopolitical Impact of the Increasing Trade and Investment Relations between the National Oil Companies of China, Iran and Russia", 19th July.
- G. Victor, D., M.Jaffe, A.and H.Hayes, M. (2006) "Politics, Market, and the shift to gas: insights from the seven historical case studies", pp. 319–357 in G.Victor et al. (eds) *Natural Gas and Geopolitics, from 1970–2040*, the UK: Cambridge University Press.
- Ghasemi, F. and Salehi, J. (2008/1387) *Theoretical approach toward the Persian Gulf*, Tehran, Iran: Middle East Strategic and Scientific Studies Centre.
- Gheorghe, A.and Muresan, L. (2011) *Energy Security: International and Local Issues, Theoretical Perspectives and critical energy infrastructure*, The Netherlands: Springer Science.
- Grix, J. (2001) *Demystifying Postgraduate Research From MA to Ph.D*, the UK: University of Birmingham Press.
- Hafeznia, M.R. (1389–2010) *An Introduction to the Research Method in Humanities*, 17th edition, Tehran, Iran: Samt Publication.
- Hafiner, M., Karbuz, S., Esnault, B. and El Andalousi, H. (2010) "Long–term natural gas supply to Europe: Import potential, infrastructure needs and investment promotion", Observatoire Mediterraneen de I'Energie (OME), Paris, France.

- Haider, H. (2005) "Energy Challenges in the post-liberalization era", European Review of Energy Markets (EREM), Vol: 1, Issue: 1, September.
- Hariri, F., Salour, K. and Mozaffarian, S. (2010) "An independent study on Iran's gas balance over the next 20 years", Idam Consulting Group.
- Hartley, P., B. Medlock, K. (2006) "The Baker Institute World Gas Trade Model", pp. 357–407, in G. Victor et al (eds) *Natural Gas and Geopolitics, from 1970–2040*, the UK: Cambridge University Press.
- Hartley, P., B. Medlock, K. (2006) "Political and economic influences on the future world market for natural gas", pp. 407–439, in G. Victor et al. (eds) *Natural Gas and Geopolitics, from 1970–2040*, the UK: Cambridge University Press.
- Hashimoto, K., Elass, J. and L. Eller, S. (2006) "Liquefied Natural Gas from Qatar: the Qatargas Project", in G. Victor et al. (eds) *Natural Gas and Geopolitics, from 1970–2040*, the UK: Cambridge University Press.
- Henderson, S. (2007) "Energy Security and Iran: Assessing the Transatlantic Divide," *Euractiv EU News Online*, 18th June.
- Henderson, S. (2012) "Israel's Natural Gas Challenges", 7th September, the Gulf and Energy Policy Program at the Washington Institute, the USA.
- Hayes, H. and G. Victor, D. (2006) "Politics, markets, and the shift to gas: insights from the seven historical case studies", pp. 319–357, in G. Victor et al. (eds) *Natural Gas and Geopolitics, from 1970–2040*, the UK: Cambridge University Press.
- Hayes, H. and G. Victor, D. (2006) "Introduction to the historical case studies: research questions, methods and case selection", pp. 3-27, in G. Victor et al. (eds) *Natural Gas and Geopolitics, from 1970–2040*, the UK: Cambridge University Press.

- Hayes. H. (2006) “The Transmed and Maghreb projects: gas to Europe from North Africa”, pp. 27–49, in G. Victor et al. (eds) *Natural Gas and Geopolitics, from 1970 – 2040*, the UK: Cambridge University Press.

- Hippel, F.V., Tatsujiro Suzuki, D., H.Williams, J., Savage, T. and Hayes, P. (2011) “Evaluating the energy security impacts of energy policies”, pp. 74–96, in K. Sovacool, B. (eds), *The Routledge Handbook of Energy Security*, , Oxon and New York: , the USA Routledge.

- Houshialsadat, M. (1388/2009) “Noboccu, the EU energy security supply”, Ettelaat Newspaper, July.

- Huntington, S. (2009) “World Natural Gas Markets and Trade: A Multi-Modeling Perspective”, *Special Issue of the Energy Journal*.

- Huntington, S. (1999) “The Lonely Superpower”, *Foreign Affairs*, 78 (2): 35–49.

- Hurst, C. (2008) “The Terrorist Threat to Liquefied Natural Gas: Fact or Fiction?”,*Oil & Gas Journal*, Institute for the Analysis of Global Security (IAGS).

- Hurst, C. (2009) “Liquefied Natural Gas: The Next Prize”, pp.271–282, in Luft Gal and Anne Korin(eds) *Energy Security Challenges for the 21st Century*, California, the USA: Greenwood Publishing Group.

- Husseinis, K. (2007) “Energy and Security in the Arab Gulf”, *Middle East Online*, 9th July.

- Imam, M.A. (1390/ 2011), *Mashal Journal–Iran’s Petroleum Ministry Weekly*, Tehran, No: 551, 26th Tir/ 17th July.

- Information Booklet First Gas Summit (2011), “Natural Gas: The Answer to the 21st Century’s Sustainable Development Challenge”, 15th November Doha, State of Qatar.

- Inkpen, A. and H. Moffett, M. (2011) "*The Global Oil & Gas Industry*", *Management, Strategy and Finance*, Penn Well Corporation, the USA.
- International Energy Agency–IEA (2003) "World Energy Investment Outlook (WEIO)", 2003 Insights, Paris, France.
- International Energy Agency–IEA (2004) "Security of Gas Supply in Open Oil Markets", An Introduction to the Energy Charter Treaty, Paris, France.
- International Energy Agency–IEA (2004) "World Energy Outlook", Paris, France.
- International Energy Agency–IEA (2004) "Biofuels for Transport–An International Perspective", Paris, France.
- International Energy Agency–IEA (2006) "Energy Policies of IEA Countries, the United Kingdom Review", Paris, France.
- International Energy Agency–IEA (2007) "World Energy Outlook", Paris, France.
- International Energy Agency–IEA (2008) "The European Union, IEA Energy Policies Review", Paris, France.
- International Energy Agency–IEA (2010) "Energy Policies of IEA countries, Italy, Review 2009", Paris, France.
- International Energy Agency–IEA (2010) "Energy Policies of IEA Countries, France 2009 Review", Paris, France.
- International Energy Agency–IEA (2010) "World Energy Outlook", Paris, France.
- International Energy Agency–IEA (2010) "Natural Gas Information", Paris, France.
- International Energy Agency–IEA (2010) "Italy: Oil and Gas Security Emergency Response of IEA Countries", Paris, France.

- International Energy Agency–IEA (2010) "the UK: Oil and Gas Security Emergency Response of IEA Countries", Paris, France.
- International Energy Agency–IEA (2011) "Spain: Oil and Gas Security Emergency Response of IEA Countries", Paris, France.
- International Energy Agency–IEA (2011) "Are We Entering a Golden Age of Gas?", Paris, France.
- International Energy Agency–IEA (2011) "Denmark Oil and Gas Security", Paris, France.
- International Energy Agency–IEA (2011) "Key World Energy Statistics", Paris, France.
- International Energy Agency–IEA Special Report (2011) "Are we entering a golden age of gas?", June Paris, France, [online], http://www.worldenergyoutlook.org/golden_age_gas.asp.
- International Gas Union–IGU (2010) "World LNG Report", Oslo, Norway.
- International Gas Union–IGU (2010) "News, views and knowledge on gas - worldwide", World LNG Report, March, Oslo, Norway.
- Iran's Ministry of Petroleum (2010) "Iran's Oil and Gas Outlook in the 1404–2023 Horizen", access at: http://www.mop.ir/portal/Home/ShowPage.aspx? Object =Event&ID.
- Jewell, J. (2011) "IEA Model of Short–term Energy Security (MOSES), Primary Energy Sources and Secondary Fuels", Working paper, Paris, France [online], http://www.iea.org/Papers/2011/moses_paper.pdf
- Joosten, G. (2005) "Energy challenges for Europe to 2010, the views of gas infrastructure operators", *European Review of Energy Markets (EREM)*, Vol: 1, Issue: 1, September.

- J. Pérez–Arriaga, I. (2007) "Security of electricity supply in Europe in a short, medium and long–term perspective", *European Review of Energy Markets (EREM)*, Vol: 2, Issue: 2, December.

- Kaderják, P., Cameron, P. and István Tóth, A. (2007) "Unilateral natural gas import dependence a new supply security issue for Europe", *European Review of Energy Markets (EREM)*, Vol: 2, Issue: 2, December.

- Kandiyoti, R. (2008) *Pipelines: Flowing Oil and Crude Politics*, New York, the USA: I.B.Taurus.

- Karbuz, S. (2012) "Mediterranean Oil & Gas Prospects to 2030: an Independent View", OME report, 25th April, Istanbul.

- Karoline, P. (2007) "the History of International Relations: Revisiting the Europe and the Rest Divide", *Geopolitics,* 12/4.

- Kashkooli, M. (1390/ 2012) *Mashal Journal –Iran's Petroleum Ministry Journal*, Tehran, No: 584, 14th Esfand/ 4th March.

- Kavalov, B., Petric´, H. and Georgakaki, A. (2009) "Liquefied Natural Gas for Europe–Some Important Issues for Consideration", Report EUR 23818 EN, Join Research Centre, European Commission.

- Keith, C., Rollie, L. and Martini, J. (2008) *"Iran's Political, Demographic, and Economic Vulnerabilities",* RAND Corporation, California, the USA.

- Kemp, G. and Harkavy, R. (1997) *Strategic Geography and the Changing Middle East*, the USA: Brookings Institution Press.

- Kemp, G. (2012) "Asianization of the Middle East", Al–Sabah Programme, Durham University, 13th September.Keppler, J (2007) "Security of energy supply: a European perspective", *European Review of Energy Markets (EREM)*, Vol: 2, Issue: 2, December.

- Khalil, H. (2007) "Energy and Security in the Arab Gulf", *Middle East Online*, Sep 7.

- Khatib, H. (2005) *"Energy and Security: Global Challenges–Regional Report"*, Security Studies Institute, Prague, Czech Republic, pp. 14–17.

- King and Spalding (2006) "LNG in Europe An Overview of European Import Terminals",[online],http://www.kslaw.com/library/pdf/LNG _in Europe.pdf.

- Kitasei, S. (2012) "Global Natural Gas Consumption Regains Momentum", *The Energy Tribune*, 3rd January.

- K. Kashgari, T. (2011) "Understanding Iran: Between Central Asia and the Gulf Cooperation Council", University of London, 5th April [online], http://www.studentpulse.com/articles/505/understanding-iran-between central-asia-and-the-gulf-cooperation-council, (Accessed 10th October 2010).

- Korkmaz, D. (2010) "Internal and External Dynamics of European Energy Security", *the Fifth Pan–European Conference on EU Politics*, University of Tampere, Finland, 23rd–26th June.

- K. Sovacool, B. and Wei Lim, T. (2011) "Exploring the contested and convergent nature of energy security", pp.414–428, in K. Sovacool, B. (eds) *The Routledge Handbook of Energy Security*, Oxon and New York, the USA: Routledge.

- Kulick, L.S. (2012) "Energy se, curity of the European Union and Russia: A relationship of interdependence", Seminar paper, GRIN ltd, Germany.Kyuyt, B., van Vuuren, D., de.Vries, Bert, J.M and Groenenberg, H. (2011) "Indicators for energy security", pp.291–313, K. Sovacool, Benjamine (eds) *The Routledge Handbook of Energy Security*, Oxon and New York, the USA: Routledge.

- Lako, P. and Kets, A. (2005) "Resources and future availability of energy sources: A quick scan", Energy Research Centre for the Netherlands (ECN).

- *LNG conference*, October 2011, Tehran, Iran.

- Lochner, S. and Bothe, D. (2009) "The development of natural gas supply costs to Europe, the United States and Japan in a globalising gas market—Model-based analysis until 2030", *Energy Policy*, No: 37, pp: 1518–1528.

- Locutura, E. (2005) "Enhancing the dimensions of the integrated European natural gas market to consolidate competition in the global market", *European Review of Energy Markets (EREM)*, Vol: 1, Issue: 1, September.

- Löschel, A., Moslener, U. and Rübbelke, D.T.G. (2010) "Indicators of energy security in industrialised countries", *Energy Policy*, Volume 38, Issue 4, pp. 1665–1671

- Lovaas, D. (2009) "Balancing Energy Security and the Environment", pp. 318–335, in Luft, Gal and Anne Korin (eds) *Energy Security Challenges for the 21st Century*, California, the USA: Greenwood Publishing Group.

- Lovatt, M. (2010) "Gas at the crossroads", *MEES (Middle East Economic Survey)*, volume LIII, No. 15.

- Luciani, G. (2005) "Oil and Political Economy in the International Relations of the Middle East", in Fawcett, Louise (eds) *the International Relations of the Middle East*, the United Kingdom: Oxford University Press.

- Luciani, G. (2012) "Energy and sustainability policies in the GCC", in Kristian Ulrichsen and David Held (eds) *the Transformation of the Gulf: Politics, economics and the global order*, the United Kingdom: Routledge.

- Luft, G. and Korine, A. (2009) *Energy Security Challenges for the 21st Century*, California, the USA: Greenwood Publishing Group.

- Luft, G. Korine, A. and Gupta, E. (2011) "Energy security and climate change: A tenuous link", pp: 43–56, in K. Sovacool, B. (eds) *The Routledge Handbook of Energy Security*, Oxon and NewYork, the USA: Routledge.

- Luft, G. (2011) "The Pipeline Paradox, Why is the United States helping Iran sell natural gas?", *Foreign Policy*, 12th April.

- Mac Donald, M. (2010) "Supplying the EU Natural Gas Market", November, Final Report, Croydo, the United Kingdom.

- Maleki, A. (2007) "Energy Supply and Demand in Eurasia: Cooperation between EU and Iran", *China and Eurasia Forum Quarterly*, Volume 5, No.4.

- Maloney, S. (2010) "Energy Security in the Persian Gulf: Opportunities and Challenges", in Pascual, C. and Elkind, J. (eds) *Energy Security: Economics, Politics, Strategies, and Implications,* Brookings Institute, Washington DC.

- Marilyn A.B. and Michael, D. (2011) "The environmental deimension of energy security", pp.176–191, in K. Sovacool, Benjamine (eds) *The Routledge Handbook of Energy Security*, Oxon and New York, the USA: Routledge.

- Market Observatory for Energy (2010) "Country file: Qatar", May.

- Masuda, T. (2007) "Security of energy supply and the geopolitics of oil and gas pipelines", European Review of Energy Markets (EREM) –Vo: 2, Issue: 2, December.

- McGowan, F. (2011) "Putting Energy Insecurity into Historical Context European Responses to the Energy Crises of the 1970s and 2000s", *Geopolitics*, 16 (3): 486–511.

- Melhem, G.A., Kalelkar, A.S., Saraf, S. and Ozog, H. (2005) "Managing LNG Risks: Separating the Facts", ioMosaic Corporation.

- Mikkelsen, A., Langhelle, O (2008), *Arctic Oil and Gas: Sustainability at Risk?*, New York, the USA: Routhledge.

- Minkova, V. (2011) "*What was the EU's Motivation for Setting out the "Critical Dialogue" Framework with Iran in the 1990s*, GRIN Verlag, Germany.

- MIT multidisciplinary report (2012), "The Future of NG", the USA.

- M. Jaffe, A., Hayes. H and G. Victor, D. (2006) "Conclusion", in G. Victor et al. (eds) *Natural Gas and Geopolitics, from 1970–2040*, the UK: Cambridge University Press.

- M. K. Bhadrakumar, A. (2010) "Pipeline Geopolitics: Major Turnaround. Russia, China, Iran Redraw Energy Map", *Asia Times*, 8th January.

- Mojtahed Zadeh, P. (2010/1389) *Political Geography and Geopolitics*, 2nd edition, Tehran, Iran: Samt Publication.

- Molavi, R. and Shareef, M. (2008) "Iran's Energy Mix and Europe's Energy Strategy", Centre for Iranian Studies, University of Durham, Michaelmas Term, No.6.

- Montazar–e–Torbati, H. (1390/ 2011) *Mashal–Iran's Petroleum Ministry Weekly,* Tehran, No: 546, 22nd Khordad/ June.

- Moradi, M. (2006) "Caspian Pipeline Politics and Iran - EU Relations", Institute for Political and International Studies (IPIS), Tehran, Iran January.

- Morata, F. and Solorio Sandoval, I. (2012) *European Energy Policy, An Environmental Approach*, the UK: Edward Elgar Publishing Limited.

- Mousavian, H. (2008) *Iran–Europe relations: challenges and opportunities,* Durham Modern Middle East and Islamic World Series, Oxon: Routledge.

- M. Pollack, K. (2012) "Security in the Persian Gulf: New Frameworks for the Twenty-First Century", *Middle East memo*, No: 24, Brookings.

- Muller–Kraenner, S. (2007) *Energy Security: re–measuring the world*, London: Earthscan.

- M. Wietfeld, A. (2011) "Understanding Middle East Gas Exporting Behavior", *the Energy Journal,* Vol: 32, No: 2.

- Naji, S. and Jawan, J. (2011) "A. Role of the Persian Gulf's Oil in the US Geopolitical Codes during the Cold War Geopolitical Order", *International Journal of Humanities and Social Science*, Vol. 1, No. 5, May.

- Németh, G., Szabó, L., Císcar, J.C., and Soria, A (2009) "Recent trends and outlook of the Spanish energy system", *European Review of Energy Markets (EREM)* , Vo: 3, Issue: 1, April.

- Observatoire Me´diterrane´en de l'E´ nergie–OME (2001) "Assessment of internal and external gas supply options for the EU, evaluation of the supply costs of new natural gas supply projects to the EU and an investigation of related financial requirements and tools", Assessment of future supply costs to Europe, June, [Online], /http://www.ome.org/PDF/Etudes/gas_study/ documents/chapter_3.pdf.

- Oettinger, G. (2010) "*Energy Security Potential for EU–GCC Cooperation*", "Security of Supply, 3rd Secure Regional Workshop, Manama, 9th November, Bahrain.

- Oettinger, G. (2010) "*Energy Strategy for Europe 2010–2020*", Brussels, 10th November, Belgium.

- Oettinger, G. (2011) "5th anniversary of the Energy Community", Wien, 24th October.

- Oettinger, G. (2011) "*SEE security of supply: EU expectations*", South Eastern Europe (SEE) gas forum hosted by TAP, Brussels, 27th October, Belgium.

- Official Journal of the European Union (2004) 'Measures to Safeguard Security of Gas Supply', 26th April, Council Directive 2004/67/EC, L127.

- Official Journal of the European Union (2009a) 'Directive 2009/28/EC of the European Parliament and of the Council of 23rd April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repeating Directives 2001/77/ EC and 2003/30/EC', Brussels.

- Official Journal of the European Union (2009c) 'Directive 2009/73/EC of 13th July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC', Brussels.
- Oil and Gas Directory Middle East, 2011.
- Oil and Gas Journal–OGJ (2011) "Special Report: Global LNG Capacities Rising to Meet Increasing Demand", 7th March, the USA.
- Oil and Energy Trends (2010) "Australia plans big increase in LNG exports", 15th January.
- Oil and Energy Trends (2010) "Iran tries again to complete South Pars", 16th April.
- Oil and Energy Trends (2010) "Iraq makes new moves on gas", 18th June.
- Oil and Energy Trends (2010) "Effect of sanctions starts to spread across Iranian energy sector", 17th September.
- Oil and Energy Trends (2011) "Gas and coal to replace oil in Australia", 21stJanuary.
- Oil and Energy Trends (2011) "Iran fights sanctions with $150 bn production plan", 18th February.
- Oil and Energy Trends (2011) "Saudis start to become serious about gas", August.
- Oil and Energy Trends (2011) "Gulf gas expansion means more liquids", Volume 36, Issue 10, October.
- Oji, J. (1390/ 2011) *Mashal Journal–Iran's Petroleum Ministry Journal*, Tehran, No: 542, 25th Ordibehesht/ 15th May.

- Oji, J. (1390/ 2011) *Mashal–Iran's Petroleum Ministry Weekly*, Tehran, No: 550, 19th Tir/ 10th July.

- Oji, J. (1390/ 2011) *Mashal–Iran's Petroleum Ministry Weekly*, Tehran, No: 553, 8th Mordad/ 29th July.

- Oktav, Ö. (2011) "The Gulf States and Iran: A Turkish Perspective," *Middle East Policy*, Vol. XVIII, No. 2, Summer.

- OPEC Energy Outlook 2011.

- O' Tuathail, G., Dolby, S, and Routledge, P. (2006) *Geopolitics Reader*, London: Routledge.

- Özden Zeynep, O. (2011) "The Gulf States and Iran: A Turkish Perspective", *Middle East Policy*, Vol. XVIII, No. 2, Summer.

- P. Amineh, M. and H. Holman, O. (2010) "The Geopolitical Impact of the Increasing Trade and Investment Relations between the National Oil Companies of China, Iran and Russia", 19th July, The Political Economy of Energy Research Project, Universiteit van Amsterdam, the Netherlands.

- Pachauri, S. (2011) "The energy poverty dimension of energy security", pp. 191–205, in K. Sovacool, B. (eds) *The Routledge Handbook of Energy Security*, Oxon and NewYork, the USA: Routledge.

- Palonkorpi, M. (2007) Energy Security and the Regional Security Complex Theory. Aleksanteri Institute. Draft

- Pascual, C. and Elkind, J. (2010) "Energy Security: Economics, Politics, Strategies, and Implications", Brookings Institute, Washington DC.

- Pascual, C. and Zambetakis, E. (2010) "The Geopolitics of Energy From Security to Survival", in Pascual, C. and Elkind, J. (eds) *Energy Security: Economics, Politics, Strategies, and Implications,* Brookings Institute, Washington DC.

- Patey, L. (2006) "Iran & the new geopolitics of oil", Danish Institute for International Studies-DIIS- Working Paper, No: 24.

- Peimani, H. (2011) *The Challenges of Energy Security in the 21st Century: Trends of Significance*, Singapore: ISEAS Publishing.

- Perle, R. (2005) *"The Nature of Terrorism... And How to Cope with It?"*, Security Studies Institute, Prague, Czech Republic, pp. 52–56.

- Piebalgs, A. (2008) "*European Energy Security*" Policy Speech at the European Brussels Summit, 21st February.

- Platts International Gas Report (2011) "Gloves come off in Spanish boardrooms", 4th July Issue 677, the USA.

- Poletti, C. and D'Orazio, A. (2009) "The Italian energy policy: changing priorities", *European Review of Energy Markets (EREM)*, Vo: 3, Issue 1, April.

- Proedrou, F. (2012) *EU Energy Security in the Gas Sector Evolving Dynamics, Policy Dilemmas and Prospects,* Surrey, England: Ashgate Publishing Limited.

- Qatar Petroleum (2007) "10 years on Qatar's first LNG shipment", Qatar Petroleum World Magazine, July, Issue:1.

- Qatar Petroleum (2011) "2010 Annual Report".

- Qatar Petroleum (2011) "Development of the Energy Sector in the State of Qatar During the Past Fifteen Years–1995–2010".

- Qatar Petroleum, "Corporate Profile".

- RAND (2009) "Saudi-Iranian Relations since the Fall of Saddam: Rivalry, Cooperation, and Implications for U.S. Policy", Santa Monica, California, the USA.

- Rasgas Magazine, Issue 34, Doha, Qatar.

- Rasgas Magazine, Issue 23, Doha, Qatar.

- Regulations over EU safeguard security of gas supply, 2010.

- Remme, U., Blesl,M., Fahl, U. (2008) "Future European gas supply in the resource triangle of the Former Soviet Union, the Middle East and Northern Africa", Energy Policy, Volume 36, Issue 5, May :1622–1641.

- Reuters (2008) "Russia, Iran, Qatar Agree To Form Big Gas Troika", 21st October, Tehran.

- RIA Novosti (2007) "Russia still pondering gas OPEC idea–Putin", 12th February.

- Robins, B. (2011) "Qatar gas challenge", Sidney Morning Herald, 30th November.

- R. Odell, P. (2002) *Oil and Gas: Crises and Controversies 1961–2000*, Volume 2: Europe's Entanglement, Brentwood, England: Multi–Science Publishing Company Ltd.

- Rogerz, P. (2009) "*Iran and the International System*", Durham University, the United Kingdom, 7th June.

- Rogers, P. (2012) "Energy Security and Iran's role in international system", in Ehteshami, A. and Molavi, R. (eds) *Iran and the International System*, Durham Modern Middle East and Islamic World Series, the UK: Routledge.

- Rosner, K. (2009) "The European Union: On Energy, Disunity", pp: 160–176, in Luft, G. and Korine, A. (eds) *Energy Security Challenges for the 21st Century,* California, the USA: Greenwood Publishing Group.

- Rosner, K. (2011) "Post Mortem on Germany's Nuclear Melt-Down", Journal of Energy Security, 28th September.

- Roze, J. (2007) "Security of gas supply for Europe", *European Review of Energy Markets (EREM)*, Vol: 2, Issue: 2, December.

- RREEF Research (2011) "Liquefied Natural Gas Market in Europe", February.
- Sabet–Saeidi, S. (2011) "Iranian-European Relations: A Strategic Partnership?", in Ehteshami, A. and Zweiri, M. (eds) *Iran's Foreign Policy; from Khatami to Ahmadinejad*, Berkshire, the UK: Ithaca Press.
- Sadeghiani, M. (2012) "The impact of Iran's tenth presidential elections on its relations with the EU and Mediterranean states", in Ehteshami, A. and Molavi, R. (eds) *Iran and the International System*, Durham Modern Middle East and Islamic World Series, the UK: Routledge.
- S.A. Gabriel, Rosendahl, K.E., Egging, R., Avetisyan, H.G., and Siddiqui, S. (2012) "Cartelization in gas markets: Studying the potential for a Gas-OPEC", *Energy Economics Journal*, No: 34.
- Sajedi, A. (2009) "Geopolitics of the Persian Gulf security: Iran and the US", *IPRI Journal IX,* No.2 , Summer.
- Sartori, N. (2011) "The Southern Gas Corridor: Needs, Opportunities and Constraints", June, Istituto Affari Internazionali (IAI) Working Papers 1108, Rome, Italy.
- Sartori, N. (2012) "The European Commission's Policy Towards the Southern Gas Corridor: Between National Interests and Economic Fundamentals", January, Istituto Affari Internazionali (IAI) Working Papers 1201, Rome, Italy.
- Schweiger, C. (2008) "The Eurozone Crisis", *The Ofi Press Magazine*, Issue: 9.
- Schweiger, C. and Wittlinger, R. (2009) "Editorial foreword: the internal dynamics of the enlarged Single European Market", *Journal of contemporary European research*, 5 (4).

- Schweiger, C. (2009) “Beyond growth jobs? Perspectives for the EU single market policy framework”, *Journal of contemporary European research*, 5 (4): 521–538.
- Schweiger, C. (2012) “International Perspectives: The European Union”, *The Arab Spring: Between Authoritarianism and Revolution*, Centre for the Advanced Study of the Arab World, School of Government and International Affairs, Durham University, the United Kingdom.
- Seznec, J.F. (2010) “Gulf Oil and Gas: What are the Producers Thinking?”, *Middle East Policy*, Vol. XVII, No. 2, Summer.
- S. Haghighi, S. (2007) *Energy Security: the External Legal Relations of the European Union with Major Oil and Gas Producing Countries*, Oxford: Hart Publishing.
- S. Hall and Powell, W. (2009) “EU Energy Markets Prepare for New Rules”, 25th May, Platt’s International Gas Report, No. 624.
- Shana Energy News Agency–Iran–(2011/1390) “Gas central role in outlook 1404”, 1st April.
- Shana Energy News Agency (Iran), 29th February 2012.
- Shenna, J. (2010) “The Case Against the Case Against Iran: Regionalism as the West’s Last Frontier”, *Middle East Journal*, Volume 64, No. 3, Summer.
- Skagen, O. (2010) “*Global gas reserves and resources: Trends, discontinuities and uncertainties*”, SSB/NAE Workshop, 18th January, Oslo, Norway.
- Soligo, R. and M. Jaffe, A. (2006) “Market structure in the new gas economy: is cartelization possible?”, pp: 437-469, in G. Victor et al. (eds) *Natural Gas and Geopolitics, from 1970–2040,* the UK: Cambridge University Press.

- Stern, J. (2002) "Security of European Natural Gas Supplies. The Impact of Import Dependence and Liberalization", The Royal institute of International Affairs, London, the United Kingdom.
- Taghavi–Asl, A. (2008) "Modern Geopolitics of Iran: From Kazakhstan to Georgia", Tehran: Foreign Policy Press.
- Takeyh, R. (2009) *Guardians of the Revolution: Iran and the World in the Age of the Ayatollahs*, the UK: Oxford University Press.
- Takin, M. (2007/1386) "Gas OPEC", *Energy Economy Quarterly*, No: 13, summer: 87–95.
- Tehran Times (2007) "Four European Companies Keen on Iran LNG Project", 28th Novermber.
- Tehran Times (2008) "Iran, Switzerland ink key gas deal", 18th March.
- Tehran Times (2010) "President orders implementation of subsidy reform plan", 25th January.
- Tehran Times (2010) "Bahrain to buy gas from Iran", 3rd September.
- *The Economist* (2007) "A gas OPEC: Don't worry, there won't be an effective gas cartel", 5th February.
- *The Pioneer* (2011) "Qatar celebrates achieving 77 Mta LNG Production Capacity", *Qatargas' magazine* May, Issue 132.
- UK Department of Energy and Climate Change (2011) "Risk assessment for the purpose of EU Regulation 994/2010 on security of gas supply", November, URN 11D/869, An addendum to the Statutory Security Report 2011, London, the United Kingdom.
- Ulrichsen, K.C. (2009) "Internal and External Security in the Arab Gulf States", *Middle East Policy*, Vol. XVI, No.2, Summer.

- Ungerer, H. (2007) "Some comments on the relationship of competition policy and European energy security", *European Review of Energy Markets (EREM)*, Vol: 2, Issue: 2, December.

- Usefi, M. and Naderian, M.A. (2011/1390) "Europe's Gas Market and Iran Strategies", June/ Tir, Institute for International Energy Studies-IIES.

- US Geological Survey–USGS (2000) "World Petroleum Assessment 2000",Washington, DC, the USA, [online], http:pubs.usgs.gov/dds/dds-060/

- Valentine, S.V. (2011) "the fuzzy nature of energy security", pp. 56–74, in K. Sovacool, B. (eds) *The Routledge Handbook of Energy Security*, Oxon and New York, the USA: Routledge.

- Van der Linde, C. (2007) "The geopolitics of EU security of gas supply", *European Review of Energy Markets (EREM)*, Vol: 2, Issue: 2, December.

- W.C. Ramsay (2008) "The External Energy Policy of the EU", The Ifri Energy Program: European Governance and Geopolitics Brussels, 31st January.

- W. Creswell, J. (2003) *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 2nd ed, California, the USA: SAGE Publications.

- White, B. (2011) "LNG industry hurt by global competition, overestimated demand", *Energy Tribune*, 11th September.

- Wicks, M. (2009) "Energy Security: A national challenge in a changing world", August, [online], access at: http://csis.org/files/media/csis/pubs/ 090130_evaluating_ .energy_security_ implications.pdf.

- World Energy Council–WEC–Report (2007) "The Role of Nuclear Power in Europe", January, London, the United Kingdom.

- World Energy Council–WEC (2007) "Survey of Energy Resources", London, the United Kingdom.

- World Energy Council–WEC (2008) “Europe’s vulnerability to energy crises”, London, the United Kingdom.

- World Energy Forum (2006) “The New Energy Security Paradigm”, Spring.

- World Gas Intelligence–WGI (2010) “GECF Falls Short of Spot Sales Deal”, 21st April.

- World Gas Intelligence–WGI (2011) “Full Steam Ahead for Several Australian, PNG LNG Projects”, 9th March, Vol. 12, No. 10.

- Xinhua News Agency, 21st February 2012, Tehran.

- Yergin, D. (2006) “Ensuring Energy Security”, *Foreign Affairs*, March/ April, Vol. 84, No. 2, pp. 69–82.

- Ying. N, Z. (2012) “Is North America the Next Middle East for Energy?”,*Energy Tribune,* 21st March.

- Young, R. (2009), “Energy Security: Europe’s New Foreign Policy Challenge”, Routledge, London.

- Zein–al–abedin, Y. (2007/1386) “The Persian Gulf Countries Geopolitical Interests”, *Political Science & International Relations Quarterly*, Tehran, Iran, Fall.

  - www.apicorp-arabia.com
  - www.cores.es/eng/home
  - www.decc.gov.uk
  - www. ec.europa.eu
  - www.eia.gov/countries
  - www.en.wikipedia.org
  - www.encharter.org
  - www.energydelta.org

- www.gecforum.org
- www.jrc.ec.europa.eu/
- www.lngjournal.org
- www.mees.com/
- www.mop.ir
- www.naturalgas.org
- www.nigec.ir
- www.ogj.com
- www.qp.com.qa
- www.rasgas.com
- www.vision1404.ir

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Annex 1: The List of Interviewees

Interviewee	Position	country	Field of expert
Dr. AfshinJavan	NG/LNG expert at IISE, ex-Total advisor	Iran	NG, LNG, regional gas markets
Ali Khayandish	The Head of Iran LNG Company	Iran	NG & LNG
Dr. Anne Korin	Co-director of the Institute for the Analysis of Global Security (IAGS)	the US	ES, PG and Iran's energy issues
Dr. Clemente Threme	Associatefellow of the Centre d'Analyse et d'Intervention Sociologiques (CADIS) & IFRI	France	The EU, Eurasia, and Iran's energy issues
David Ledesma	NG and LNG consultant at the OIES	The UK	NG & LNG
Prof. GawdatBahgat	Uni. of Washington D.C	The U.S	ES, PG, GCC, and Iran's energy issues
Prof.GiacomoLuciani	Gulf Research Centre	France	ES, PG, GCC, and Iran's energy issues
Pro. Gonzalo Escribano	Uni. Of UNED in Spain & Florida State Uni. in the US & Member of Euro-Mediterranean Network	Spain	EU ES, gas corridors, Spanish EP
Mr.HosseinHassantash	Member of IIES' Board & ex-Parliamentarian in Energy Commission	Iran	Iran's EP, NG/ LNG corridors
Prof. HoomanPeimani	The Head ES Division for the Energy Studies Institute, National Uni. Of Singapore	Singapore	ES, PG and Iran oil and gas
HosseinBidarmaghz	The Head of Iran's Gas Export Company	Iran	NG, LNG, Iran's gas policy
Howard Rogers	Director of the NG Program at the OIES	The UK	NG & LNG
IngeBernaerts	Head of Unit for Electricity and Gas within DG ENER for the European	Belgium	EU EP & ES

	Commission		
Karen Sund	The Head of Sund Energy Institute	Norway	EU EP & ES, NG/ LNG routes
Javad Oji	The managing director of the National Iranian Gas Company (NIGC)	Tehran	Iran's NG/LNG policies
Laura El-Katiri	NG and LNG consultant at the OIES	The UK	EP in the ME/ GCC; NG & LNG
Matthew Hulbert	Clingendael International Energy Programme	The UK	**Energy adviser**
Michael Koehler	The Energy Commissioner for the EU's Institute	Germany	EU's EP
Mohsen Ghamsari	The Head of Internationalization for Iran's National Oil Company & The Board Member of Iran LNG	Iran	Oil, NG, LNG, Iran's energy policy
Dr.MostafaIranmanesh	The Head of IIES	Iran	NG, LNG, Iran's energy policy
Dr.NicolòSartori	IstitutoAffariInternazionali	Italy	EU ES, NG/ LNG corridors, Italy's EP
Prof. Paul Rogers	Bradford Uni. & Consultant for Oxford Research Group	The UK	ES, PG and Iran oil and gas
Pro. Pirouz Mojtahed Zadeh	The Head of Eurocivic Institute	The UK	Energy Geopolitian
Thierry Coville	Energy expert in Institute for International & Strategic Relations (IRIS)	France	Iran, France, and the EU EP & ES, NG/ LNG issues

The name of above experts have been located on the basis of alphabetical order

Source: By Author

Annex 2: The list of energy organizations and institutes

Energy Organization/ Ministry/ Institute/ Think Tank	Country
Asia Pacific Energy Research Centre (APERC)	Tokyo, Japan
British Institute of Energy Economics	The UK
➢ British Petroleum (BP)	London, The UK
➢ CEDIGAZ	France
Center for Applied Policy Research (CAP) at the Uni. of Munich	Germany
Centre for Energy at the Dundee University	The UK
Centre for European Policy Studies (CEPS)	Brussels, Belgium
➢ Centre for European Reform	London, The UK
Chatham House, energy and environment section	London, The UK
➢ Clingendael, Netherlands Institute of International Relations	The Hague, The Netherlands
Emirates Centre for Strategic Studies and Research (ECSSR)	The U.A.E
Enagas	Spain
Energy Delta Institute (EDI)	Groningen, The Netherland
Energy Research Centre	London, The UK
Energy Research Centre of the Netherlands (ECN)	Petten, The Nethrlands
Energy Studies Institute, National University of Singapore	Singapore
➢ European Commission's Director-General for Energy	Brussels, Belgium
➢ EU energy commissioner's institute	Brussels, Belgium
➢ Eurostat, as the statistical office of the European Commission	Luxembourg
FRIDE, A European Think Tank for Global Action	Madrid, Spain

Gas Terra	Groningen, the Netherland
Gulf Research Centre (Dubai, Geneva, and Cambridge)	The U.A.E, The UK, & Switzerland
➢ Institute for International Energy Studies (IIES)	Tehran, Iran
➢ Institute for the Analysis of Global Security (IAGS)	The U.S
➢ Institute of Energy Economics at the University of Cologne (EWI)	Germany
Institute of Energy for South East Europe	Athens, Greece
➢ Institut français des relations internationales (Ifri)	France
Institute for International & Strategic Relations/ Institut de Relations Internationales et Strategiques (IRIS)	France
➢ International Energy Agency (IEA)	Paris, France
➢ International Gas Union (IGU)	Oslo, Norway
➢ Istituto Affari Internazionali	Roma, Italy
➢ James A. Baker III Institute for Public Policy at the Uni. Of Rice	Houston, the U.S
➢ Joint Research Centre, Institute for Energy and Transport, DG European Commission	Petten, The Nethrlands
Ministry of Economic Development, Department of Energy	Italy
➢ Ministry of Petroleum	Iran
➢ National Iran Gas Export Company	Iran
➢ Obervatoire Mediterraneen de l'Energie (OME)	Nanterre, France
➢ Oxford Institute for Energy Studies (OIES)	The UK
➢ Platts	New York, the U.S
➢ Qatar Petroleum	Duha, Qatar
Real Instituto Elcano	spain
➢ U.S Energy Information Administrative (EIA)	Washington, the US
➢ World Energy Organization (WEO)	London, The UK

➢ Wood Mackenzie	Edinburgh, Scotland and 14 countries

➢ These energy centers have been used more than the other ones, based on alphabetical order

Source: By Author

Annex 3: The list of used journals

The Name of Journals	
Energy Economics	Energy Economy Quarterly
➢ Energy Journal	➢ Energy Policy
➢ Energy Tribune	➢ European Review on Energy Market
Geopolitics	International Gas Union Magazine Journal
Journal of Asian Studies	➢ Journal of Energy Security (by IAGS)
Journal of Energy Economics (by IIES)	➢ LNG Journal
➢ Mashal (Flame, in English), Iran's Petoleum Ministry	Middle East Journal
➢ Middle East Policy	Middle East Quarterly
➢ Official Journal of the European Union (by EUR-Lex)	➢ Oil & Gas Journal
➢ Oil & Gas Trends	➢ Rasgas Magazine
Scandinavian Oil & Gas Magazine	World Gas Intelligence
International Journal of Energy Sector Management	

- These journals have been used more than the other ones, based on alphabetical order, left to right

Source: By Author

Annex 4: The Interview Questions

I. What is the position of Iran & Qatar's LNG export amongst the exporters to Italy, Spain, the UK, and France by 2020?

- The LNG export from current suppliers, such as North African countries, Nigeria, and Qatar to these four EU member states will still be adequate in the future, despite rise of import capacity in the EU;
- Iran's LNG export and Qatar's expansion would be important for the EU security of gas supply in the future;

More comments:

II. Which is/are the most important barriers for the LNG export from Iran to the prominent EU LNG developers in the future and what are the main challenges for this LNG relation? (one or more options)

- Political and security disputes and instability within the Persian Gulf;
- Political disparate between Iran and the most important western countries and the sanctions imposed on Tehran over its nuclear program;
- Different political will and views among the EU members;
- The US massive attendance in the PG region;
- Technical problems within the Iranian gas, particularly LNG industry;

More comments:

III.If Iran's LNG programs will be quite materialized in coming years, and Qatar will also increase its export toward the four EU members, which achievements will be perceived for both sides politically and economically in the future?

- More stability within the PG region, leading to further international steadiness;
- Ensuring of more energy security within the EU & PG by diversifying of importers and exporters, as well as energy sources;
- Investment within the PG gas reserves is cheaper, so the price of final gas supply might be more suitable for the EU;
- Nearly one – third of global gas reserves are situated in Iran & Qatar, so this LNG supply toward the EU will ensure its energy security because of this availability;

More comments:

IV.In your opinion, as Qatar will have to export gas to some other sheikhdoms within the PG, like UAE, Oman, and maybe Bahrain and also should send more LNG toward the East Asian countries, such as South Korea, Japan, China after opening up the two new LNG facilities, is there any possibility that Qatar will increase its LNG export capacity toward the coming EU LNG regasification terminals in the future?

V.I most be grateful if you mention some more points in this respect, help me analyze this probable cooperation between these two regions and case studies within them.

- In certain interviews, some more questions have been asked from certain interviewees, in addition of above ones, depending on the time and conditions.

Annex 5: Research Ethics Policy, SGIA, Durham University

Durham University
School of Government and International Affairs

Research Ethics Policy

Principles

The School's research ethics policy is guided by the following principles:

1. All research, by undergraduates, postgraduates and members of staff that involves living subjects must involve the understanding and application of relevant ethical considerations.
2. It is ethically appropriate that research should be competently and suitably conducted, but this does not imply favouring any particular method.
3. Stricter ethical procedures apply where participants are vulnerable or are unable to give informed consent, such as social services users or people legally deemed non-competent.
4. Other circumstances where particular attention to ethical issues is necessary include when participants would take part in a study without their knowledge or consent at the time (but see 6 (a)), when the study would involve discussion of sensitive topics, when the study could cause discomfort or harm beyond the risks encountered in normal life, and when financial inducements are to be used.
5. Please refer to the Economic and Social Research Council's (ESRC) Research Ethics Framework (REF)
6. Informed consent must always be obtained at a level which is appropriate for the research process concerned. Thus:
   (a) Consent is not required for ethnographic and related observational studies conducted in locales where people would normally expect their behaviour and actions to be observable by others.
   (b) Consent in relation to interview research, including interviews conducted as part of a social survey or participation in focus groups, should be based on simple agreement to participate in the interview process with the right to withdraw at any point.
7. Where a guarantee of anonymity is given as part of the process of obtaining consent, this must be strictly observed at all parts of the research process and in written outputs.
8. Research involving deception on the part of the researcher raises particular ethical issues. It is not automatically unethical but research involving deception must always be based on a specific justification of the use of deception.
9. There should be provision for feedback on the results of the research to be given to participants if they request it, unless a justification for withholding it is provided.

Procedures

1. All research done under the auspices of the School, including independent or semi-independent research by undergraduates in projects or dissertations must be done in compliance with the principles stated above. To this end all proposed research should be evaluated, if necessary modified, and approved with respect to its ethical implications.

2. Specifically, all research proposals should be accompanied by a completed Ethical Implications form. This will be received and evaluated in the first instance as follows:

Researcher category		*Form received by:*
Staff		Chairman or Chairwoman of the Ethics Committee (or another member of the Ethics Committee)
Postgraduates:	Research students	Director of Postgraduate Studies
	Taught MA Dissertations	Dissertation Supervisor
Undergraduates:	Dissertations	Dissertation Supervisor
	Projects	Module Convenor or other full-time staff teaching module

3. In the case of modules in which semi-independent research takes place in a structured series of steps, provision must be made for the submission of the Ethical Implications form at an early stage, alongside initial research proposals, at a date indicated in the module booklet.
4. In the case of undergraduate and taught MA dissertations, the Ethical Implications form must be submitted to the prospective supervisor alongside the form specifying the topic and supervisor.
5. In the case of research students, the Ethical Implications form must be submitted in advance of the student being admitted and preferably alongside the student's application.
6. In cases where there are no ethical implications or when ethical implications have been satisfactorily addressed in the proposal, the initial recipient of the completed form will endorse it to that effect and pass it on to the School office for record keeping.
7. In cases where ethical implications have not been satisfactorily addressed in the proposal, or external evaluation is required, the initial recipient of the completed form will endorse it to that effect and pass it on to the Ethics Committee for further consideration.
8. The Ethics Committee will be responsible for monitoring the submission of forms, resolving problematic cases by modifying the research proposal, and reporting annually to the Board of Studies and the relevant Faculty committee.
9. Prospective recipients of the Ethical Implications form are encouraged to discuss and resolve ethical problems with the prospective researcher in advance of submission of a proposal.

SW
Amended Research Committee October 2008

Annex 6: Global gas production since 2000 to 2010

Production*

Billion cubic metres	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	**2010**	Change 2010 over 2009	2010 share of total
US	543.2	555.5	536.0	540.8	526.4	511.1	524.0	545.6	570.8	582.8	**611.0**	4.7%	19.3%
Canada	182.2	186.5	187.9	184.7	183.7	187.1	188.4	182.5	176.4	163.9	**159.8**	-2.5%	5.0%
Mexico	38.3	38.2	39.4	41.1	42.6	45.0	51.5	53.6	54.2	54.9	**55.3**	0.7%	1.7%
Total North America	763.7	780.1	763.3	766.6	752.8	743.3	763.9	781.6	801.5	801.6	**826.1**	3.0%	26.0%
Argentina	37.4	37.1	36.1	41.0	44.9	45.6	46.1	44.8	44.1	41.4	**40.1**	-3.0%	1.3%
Bolivia	3.2	4.7	4.9	6.4	9.8	11.9	12.9	13.8	14.3	12.3	**14.4**	16.8%	0.4%
Brazil	7.5	7.7	9.2	10.0	11.0	11.0	11.3	11.2	13.7	11.7	**14.4**	23.5%	0.5%
Colombia	5.9	6.1	6.2	6.1	6.4	6.7	7.0	7.5	9.1	10.5	**11.3**	7.2%	0.4%
Peru	0.3	0.4	0.4	0.5	0.9	1.5	1.8	2.7	3.4	3.5	**7.2**	108.4%	0.2%
Trinidad & Tobago	14.5	15.5	18.0	26.3	27.3	31.0	36.4	39.0	39.3	40.6	**42.4**	4.4%	1.3%
Venezuela	27.9	29.6	28.4	25.2	28.4	27.4	31.5	29.5	30.0	28.7	**28.5**	-0.7%	0.9%
Other S. & Cent. America	3.4	3.5	3.4	3.1	3.1	3.4	4.1	3.9	3.7	3.2	**2.9**	-9.9%	0.1%
Total S. & Cent. America	100.2	104.5	106.7	118.7	131.7	138.6	151.1	152.5	157.6	151.9	**161.2**	6.2%	5.0%
Azerbaijan	5.1	5.0	4.7	4.6	4.5	5.2	6.1	9.8	14.8	14.8	**15.1**	2.2%	0.5%
Denmark	8.2	8.4	8.4	8.0	9.4	10.4	10.4	9.2	10.1	8.4	**8.2**	-3.0%	0.3%
Germany	16.9	17.0	17.0	17.7	16.4	15.8	15.6	14.3	13.0	12.2	**10.6**	-12.7%	0.3%
Italy	15.2	14.0	13.4	12.7	11.9	11.1	10.1	8.9	8.5	7.3	**7.6**	3.6%	0.2%
Kazakhstan	10.4	10.5	10.2	12.6	20.0	22.6	23.9	26.8	29.8	32.5	**33.6**	3.3%	1.1%
Netherlands	58.1	62.4	60.3	58.1	68.5	62.5	61.6	60.5	66.6	62.7	**70.5**	12.4%	2.2%
Norway	49.7	53.9	65.5	73.1	78.5	85.0	87.6	89.7	99.3	103.7	**106.4**	2.5%	3.3%
Poland	3.7	3.9	4.0	4.0	4.4	4.3	4.3	4.3	4.1	4.1	**4.1**	0.5%	0.1%
Romania	13.8	13.6	13.2	13.0	12.8	12.4	11.9	11.5	11.4	11.3	**10.9**	-2.9%	0.3%
Russian Federation	528.5	526.2	538.8	561.5	573.3	580.1	595.2	592.0	601.7	527.7	**588.9**	11.6%	18.4%
Turkmenistan	42.5	46.4	48.4	53.5	52.8	57.0	60.4	65.4	66.1	36.4	**42.4**	16.4%	1.3%
Ukraine	16.2	16.6	17.0	17.6	18.4	18.6	18.7	18.7	19.0	19.3	**18.6**	-3.8%	0.6%
United Kingdom	108.4	105.8	103.6	102.9	96.4	88.2	80.0	72.1	69.6	59.7	**57.1**	-4.3%	1.8%
Uzbekistan	51.1	52.0	51.9	52.0	54.2	54.0	54.5	59.1	62.2	60.0	**59.1**	-1.5%	1.8%
Other Europe & Eurasia	11.1	10.9	11.2	10.6	11.0	10.9	11.5	10.8	10.3	9.7	**10.0**	3.0%	0.3%
Total Europe & Eurasia	938.9	946.6	967.6	1001.9	1032.3	1038.0	1051.7	1053.2	1086.5	969.8	**1043.1**	7.6%	32.6%
Bahrain	8.8	9.1	9.5	9.6	9.8	10.7	11.3	11.8	12.7	12.8	**13.1**	2.4%	0.4%
Iran	60.2	66.0	75.0	81.5	84.9	103.5	108.6	111.9	116.3	131.2	**138.5**	5.6%	4.3%
Iraq	3.2	2.8	2.4	1.6	1.0	1.5	1.5	1.5	1.9	1.2	**1.3**	8.7%	◆
Kuwait	9.6	10.5	9.5	11.0	11.9	12.2	12.5	12.1	12.8	11.2	**11.6**	3.5%	0.4%
Oman	8.7	14.0	15.0	16.5	18.5	19.8	23.7	24.0	24.1	24.8	**27.1**	9.4%	0.8%
Qatar	23.7	27.0	29.5	31.4	39.2	45.8	50.7	63.2	77.0	89.3	**116.7**	30.7%	3.6%
Saudi Arabia	49.8	53.7	56.7	60.1	65.7	71.2	73.5	74.4	80.4	78.5	**83.9**	7.0%	2.6%
Syria	5.5	5.0	6.1	6.2	6.4	5.5	5.7	5.6	5.3	5.7	**7.8**	37.3%	0.2%
United Arab Emirates	38.4	44.9	43.4	44.8	46.3	47.8	49.0	50.3	50.2	48.8	**51.0**	4.5%	1.6%
Yemen	–	–	–	–	–	–	–	–	–	0.8	**6.2**	704.6%	0.2%
Other Middle East	0.3	0.3	0.3	0.3	1.5	1.9	2.6	3.0	3.7	3.1	**3.5**	15.0%	0.1%
Total Middle East	208.1	233.3	247.2	262.9	285.1	319.9	339.1	357.8	384.3	407.1	**460.7**	13.2%	14.4%
Algeria	84.4	78.2	80.4	82.8	82.0	88.2	84.5	84.8	85.8	79.6	**80.4**	1.1%	2.5%
Egypt	21.0	25.2	27.3	30.1	33.0	42.5	54.7	55.7	59.0	62.7	**61.3**	-2.2%	1.9%
Libya	5.9	6.2	5.9	5.5	8.1	11.3	13.2	15.3	15.9	15.9	**15.8**	-0.6%	0.5%
Nigeria	12.5	14.9	14.2	19.2	22.8	22.4	28.4	35.0	35.0	24.8	**33.6**	35.7%	1.1%
Other Africa	6.5	6.9	6.6	7.2	8.9	9.9	10.4	12.3	15.8	16.3	**17.8**	9.4%	0.6%
Total Africa	130.3	131.5	134.4	144.9	154.7	174.3	191.2	203.1	211.5	199.2	**209.0**	4.9%	6.5%
Australia	31.2	32.1	32.2	32.7	35.8	37.2	40.2	41.9	41.6	47.9	**50.4**	5.1%	1.6%
Bangladesh	10.0	10.7	11.4	12.3	13.2	14.5	15.3	16.3	17.9	19.7	**20.0**	1.3%	0.6%
Brunei	11.3	11.4	11.5	12.4	12.2	12.0	12.6	12.3	12.2	11.4	**12.2**	6.7%	0.4%
China	27.2	30.3	32.7	35.0	41.5	49.3	58.6	69.2	80.3	85.3	**96.8**	13.5%	3.0%
India	26.4	26.4	27.6	29.5	29.2	29.6	29.3	30.1	30.5	39.2	**50.9**	29.7%	1.6%
Indonesia	65.2	63.3	69.7	73.2	70.3	71.2	70.3	67.6	69.7	71.9	**82.0**	14.0%	2.6%
Malaysia	45.3	46.9	48.3	51.8	53.9	61.1	63.3	64.6	64.7	64.1	**66.5**	3.7%	2.1%
Myanmar	3.4	7.0	8.4	9.6	10.2	12.2	12.6	13.5	12.4	11.5	**12.1**	4.9%	0.4%
Pakistan	21.5	22.7	24.6	30.4	34.5	35.5	36.1	36.8	37.5	38.4	**39.5**	2.7%	1.2%
Thailand	20.2	19.6	20.5	21.5	22.4	23.7	24.3	26.0	28.8	30.9	**36.3**	17.4%	1.1%
Vietnam	1.6	2.0	2.4	2.4	4.2	6.4	7.0	7.1	7.5	8.0	**9.4**	16.7%	0.3%
Other Asia Pacific	9.0	9.5	10.9	10.7	10.1	11.1	14.2	16.9	17.7	17.9	**17.3**	-3.4%	0.5%
Total Asia Pacific	272.1	282.0	300.2	321.6	337.4	363.9	383.7	402.2	420.7	446.4	**493.2**	10.5%	15.4%
Total World	**2413.4**	**2478.0**	**2519.4**	**2616.5**	**2694.0**	**2778.0**	**2880.7**	**2950.5**	**3062.1**	**2975.9**	**3193.3**	**7.3%**	**100.0%**
of which: OECD	1073.9	1096.6	1086.4	1092.8	1091.9	1076.4	1092.9	1102.2	1134.3	1126.3	**1159.8**	2.9%	36.5%
Non-OECD	1339.5	1381.4	1433.0	1523.7	1602.1	1701.6	1787.9	1848.3	1927.8	1849.5	**2033.5**	9.9%	63.5%
European Union	231.9	232.8	227.6	223.6	227.3	212.0	201.3	187.5	189.4	171.5	**174.9**	2.0%	5.5%
Former Soviet Union	654.2	657.1	671.4	702.1	723.4	737.7	759.0	772.1	793.8	690.9	**757.9**	9.7%	23.7%

*Excluding gas flared or recycled.
◆Less than 0.05%.

Source: Includes data from Cedigaz.

Source: BP Statistical Review of World Energy, June 2011

Annex 7: World's natural gas production by region/country, 2008–2035 (tcf)

Region/country	History 2008	History 2009	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2008-2035
OECD								
United States[a]	20.2	20.1	22.4	23.4	24.0	25.1	26.4	1.0
Conventional	9.4	8.4	7.7	7.8	6.8	6.8	6.6	-1.3
Unconventional	10.9	11.7	14.8	15.6	17.1	18.4	19.8	2.3
Canada	6.0	5.6	7.0	7.7	8.3	8.7	9.0	1.5
Conventional	4.0	3.6	4.3	4.3	4.4	4.4	4.4	0.4
Unconventional	2.1	2.0	2.7	3.4	3.9	4.3	4.6	3.0
Europe	10.6	10.1	8.1	7.5	7.5	7.9	8.3	-0.9
Conventional	10.6	10.1	8.1	7.1	6.6	6.2	6.0	-2.1
Unconventional	0.0	0.0	0.1	0.3	0.9	1.7	2.3	19.1
Australia/New Zealand	1.7	1.8	2.6	3.1	3.8	4.8	5.7	4.5
Other OECD	1.9	2.0	2.1	2.0	2.0	2.1	2.4	0.9
Total OECD	**40.6**	**39.6**	**42.3**	**43.7**	**45.5**	**48.7**	**51.8**	**0.9**
Non-OECD								
Russia	23.4	20.6	23.0	24.9	27.3	29.6	31.2	1.1
Europe and Central Asia	7.1	5.7	7.4	7.7	8.1	8.7	9.2	1.0
Iran	4.1	4.6	5.7	6.9	7.8	8.6	9.4	3.1
Qatar	2.7	3.2	6.3	7.0	7.4	7.8	8.1	4.1
Other Middle East	6.7	6.6	7.8	8.5	9.4	10.4	11.3	2.0
North Africa	5.8	5.8	7.4	8.5	9.3	10.0	10.4	2.2
Other Africa	1.7	1.4	2.4	2.6	2.9	3.3	3.7	3.0
China	2.7	2.9	3.1	3.7	4.7	6.0	7.3	3.8
Conventional	2.7	2.9	2.6	2.3	2.2	2.1	2.0	-1.0
Unconventional	0.0	0.0	0.5	1.4	2.6	3.9	5.2	--
Other Asia	10.0	10.4	12.5	13.7	14.9	16.2	17.3	2.0
Central and South America	5.1	4.9	5.8	6.6	7.5	8.5	9.5	2.3
Total non-OECD	**69.3**	**66.0**	**81.3**	**90.0**	**99.4**	**109.1**	**117.4**	**2.0**
Total world	**109.9**	**105.6**	**123.6**	**133.8**	**145.0**	**157.8**	**169.2**	**1.6**

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Annex 8: World's gas Consumption

Consumption

Billion cubic metres	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Change 2010 over 2009	2010 share of total
US	660.7	629.7	651.5	630.8	634.0	623.3	614.1	654.0	658.9	646.7	**683.4**	5.6%	21.7%
Canada	92.7	88.2	90.2	97.7	95.1	97.8	96.9	95.2	95.5	94.4	**93.8**	-0.6%	3.0%
Mexico	41.0	41.7	45.3	50.1	53.4	53.8	60.9	62.8	66.4	66.6	**68.9**	3.4%	2.2%
Total North America	794.4	759.6	787.0	778.6	782.5	774.9	771.9	812.1	820.8	807.7	**846.1**	4.7%	26.9%
Argentina	33.2	31.1	30.3	34.6	37.9	40.4	41.8	43.9	44.4	43.2	**43.3**	0.4%	1.4%
Brazil	9.4	11.9	14.1	15.8	18.8	19.7	20.8	21.1	24.6	19.8	**26.5**	33.8%	0.8%
Chile	6.5	7.3	7.4	8.0	8.7	8.4	7.8	4.6	2.7	3.1	**4.7**	51.0%	0.1%
Colombia	5.9	6.1	6.1	6.0	6.3	6.7	7.0	7.4	7.6	8.7	**9.1**	4.3%	0.3%
Ecuador	0.3	0.3	0.2	0.3	0.3	0.4	0.7	0.5	0.5	0.5	**0.5**	-6.0%	♦
Peru	0.3	0.4	0.4	0.5	0.9	1.5	1.8	2.7	3.4	3.5	**5.4**	56.0%	0.2%
Trinidad & Tobago	10.6	11.6	12.7	14.4	13.4	15.1	20.2	20.3	21.9	20.9	**22.0**	5.5%	0.7%
Venezuela	27.9	29.6	28.4	25.2	28.4	27.4	31.5	29.6	31.5	30.5	**30.7**	0.6%	1.0%
Other S. & Cent. America	1.8	2.3	2.4	3.1	2.9	3.3	3.9	4.5	4.7	5.1	**5.6**	9.9%	0.2%
Total S. & Cent. America	96.0	100.7	102.1	107.9	117.5	122.9	135.5	134.6	141.3	135.1	**147.7**	9.3%	4.7%
Austria	8.1	8.6	8.5	9.4	9.5	10.0	9.4	8.9	9.5	9.3	**10.1**	8.6%	0.3%
Azerbaijan	5.2	7.5	7.5	7.7	8.3	8.6	9.1	8.0	9.2	7.8	**6.6**	-15.9%	0.2%
Belarus	15.7	15.7	16.1	15.8	17.9	18.4	19.0	18.8	19.2	16.1	**19.7**	22.3%	0.6%
Belgium & Luxembourg	15.6	15.4	15.7	16.6	16.9	17.1	17.1	17.0	17.2	17.5	**19.4**	10.9%	0.6%
Bulgaria	3.3	3.0	2.7	2.8	2.8	3.1	3.2	3.2	3.2	2.3	**2.6**	10.1%	0.1%
Czech Republic	8.3	8.9	8.7	8.7	9.1	9.6	9.3	8.7	8.7	8.2	**9.3**	13.7%	0.3%
Denmark	4.9	5.1	5.1	5.2	5.2	5.0	5.1	4.6	4.6	4.4	**4.9**	12.2%	0.2%
Finland	3.7	4.1	4.0	4.5	4.3	4.0	4.2	3.9	4.0	3.6	**3.9**	9.9%	0.1%
France	39.3	41.9	40.5	43.0	45.1	44.0	42.1	42.4	43.8	42.2	**46.9**	11.1%	1.5%
Germany	79.5	82.9	82.6	85.5	85.9	86.2	87.2	82.9	81.2	78.0	**81.3**	4.2%	2.6%
Greece	2.0	2.0	2.1	2.4	2.7	2.7	3.1	3.8	4.0	3.4	**3.7**	8.2%	0.1%
Hungary	10.7	11.9	11.8	13.2	13.0	13.4	12.7	11.9	11.8	10.1	**10.9**	7.7%	0.3%
Republic of Ireland	3.8	4.0	4.1	4.1	4.1	3.9	4.5	4.8	5.0	4.8	**5.3**	10.8%	0.2%
Italy	64.9	65.0	64.6	71.2	73.9	79.1	77.4	77.8	77.8	71.5	**76.1**	6.4%	2.4%
Kazakhstan	9.5	10.2	14.8	17.6	25.0	26.8	28.1	26.4	27.2	24.5	**25.3**	2.9%	0.8%
Lithuania	2.7	2.8	2.9	3.1	3.1	3.3	3.2	3.6	3.2	2.7	**3.1**	14.3%	0.1%
Netherlands	38.9	40.0	39.8	40.0	40.9	39.3	38.1	37.0	38.6	38.9	**43.6**	12.1%	1.4%
Norway	4.0	3.8	4.0	4.3	4.6	4.5	4.4	4.3	4.3	4.1	**4.1**	-0.5%	0.1%
Poland	11.1	11.5	11.2	12.5	13.2	13.6	13.7	13.8	13.9	13.4	**14.3**	7.1%	0.5%
Portugal	2.4	2.6	3.1	3.0	3.8	4.2	4.1	4.3	4.6	4.7	**5.0**	6.7%	0.2%
Romania	17.1	16.6	17.2	18.3	17.5	17.6	18.1	16.1	15.9	13.3	**13.3**	0.6%	0.4%
Russian Federation	354.0	366.2	367.7	384.9	394.1	400.3	408.5	422.1	416.0	389.6	**414.1**	6.3%	13.0%
Slovakia	6.5	6.9	6.5	6.3	6.1	6.6	6.0	5.7	5.7	4.9	**5.6**	14.5%	0.2%
Spain	16.9	18.2	20.8	23.6	27.4	32.4	33.7	35.1	38.6	34.6	**34.4**	-0.3%	1.1%
Sweden	0.7	0.7	0.8	0.8	0.8	0.8	0.9	1.0	0.9	1.1	**1.6**	38.9%	0.1%
Switzerland	2.7	2.8	2.8	2.9	3.0	3.1	3.0	2.9	3.1	3.0	**3.3**	10.5%	0.1%
Turkey	14.6	16.0	17.4	20.9	22.1	26.9	30.5	36.1	37.5	35.7	**39.0**	9.2%	1.2%
Turkmenistan	12.2	12.5	12.9	14.2	15.0	16.1	18.4	21.3	20.5	19.9	**22.6**	13.5%	0.7%
Ukraine	71.0	68.8	67.7	69.0	68.5	69.0	67.0	63.2	60.0	47.0	**52.1**	11.0%	1.6%
United Kingdom	96.9	96.4	95.1	95.4	97.4	95.0	90.1	91.1	93.8	86.7	**93.8**	8.3%	3.0%
Uzbekistan	45.7	49.6	50.9	45.8	43.4	42.7	41.9	45.9	48.7	43.5	**45.5**	4.6%	1.4%
Other Europe & Eurasia	13.2	14.5	13.6	14.1	15.6	15.9	16.4	17.0	16.1	13.7	**15.7**	14.9%	0.5%
Total Europe & Eurasia	985.3	1016.1	1023.2	1067.1	1100.1	1122.8	1129.5	1143.5	1148.2	1060.5	**1137.2**	7.2%	35.8%
Iran	62.9	70.1	79.2	82.9	86.5	105.0	108.7	113.0	119.3	131.4	**136.9**	4.2%	4.3%
Israel	†	†	†	†	1.2	1.7	2.3	2.8	4.1	4.5	**5.3**	17.5%	0.2%
Kuwait	9.6	10.5	9.5	11.0	11.9	12.2	12.5	12.1	12.8	12.1	**14.4**	18.8%	0.5%
Qatar	9.7	11.0	11.1	12.2	15.0	18.7	19.6	19.3	19.3	20.0	**20.4**	2.0%	0.6%
Saudi Arabia	49.8	53.7	56.7	60.1	65.7	71.2	73.5	74.4	80.4	78.5	**83.9**	7.0%	2.6%
United Arab Emirates	31.4	37.9	36.4	37.9	40.2	42.1	43.4	49.2	59.5	59.1	**60.5**	2.5%	1.9%
Other Middle East	23.3	23.7	24.6	25.0	26.5	28.4	31.5	32.3	36.5	38.6	**44.1**	14.1%	1.4%
Total Middle East	186.7	206.8	217.6	229.0	247.1	279.2	291.5	303.1	331.9	344.1	**365.5**	6.2%	11.5%
Algeria	19.8	20.5	20.2	21.4	22.0	23.2	23.7	24.3	25.4	27.2	**28.9**	6.0%	0.9%
Egypt	20.0	24.5	26.5	29.7	31.7	31.6	36.5	38.4	40.8	42.5	**45.1**	6.0%	1.4%
South Africa	1.2	1.2	1.0	1.0	2.1	3.1	3.5	3.5	3.7	3.4	**3.8**	13.8%	0.1%
Other Africa	17.4	17.6	18.0	20.4	23.8	25.0	24.4	28.3	30.2	25.7	**27.1**	5.5%	0.9%
Total Africa	58.4	63.8	65.8	72.6	79.7	83.0	88.1	94.4	100.1	98.9	**105.0**	6.1%	3.3%
Australia	20.5	21.6	22.0	22.0	23.4	22.0	25.3	27.6	28.8	30.7	**30.4**	-1.2%	1.0%
Bangladesh	10.0	10.7	11.4	12.3	13.2	14.5	15.3	16.3	17.9	19.7	**20.0**	1.3%	0.6%
China	24.5	27.4	29.2	33.9	39.7	46.8	56.1	70.5	81.3	89.5	**109.0**	21.8%	3.4%
China Hong Kong SAR	3.0	3.0	2.9	1.8	2.7	2.7	2.9	2.7	3.2	3.1	**3.8**	24.3%	0.1%
India	26.4	26.4	27.6	29.5	31.9	35.7	37.3	40.1	41.3	51.0	**61.9**	21.5%	1.9%
Indonesia	29.7	31.0	32.9	35.0	32.2	33.2	33.2	31.3	33.3	37.4	**40.3**	7.8%	1.3%
Japan	72.3	74.3	72.7	79.8	77.0	78.6	83.7	90.2	93.7	87.4	**94.5**	8.1%	3.0%
Malaysia	24.1	25.2	26.2	27.3	24.7	31.4	33.7	33.4	33.8	33.7	**35.7**	6.2%	1.1%
New Zealand	5.6	5.9	5.6	4.3	3.9	3.6	3.7	4.1	3.8	3.9	**4.1**	4.2%	0.1%
Pakistan	21.5	22.7	24.6	30.4	34.5	35.5	36.1	36.8	37.5	38.4	**39.5**	2.7%	1.2%
Philippines	†	0.1	1.8	2.7	2.5	3.3	2.6	3.2	3.3	3.3	**3.1**	-5.8%	0.1%
Singapore	†	0.9	3.6	4.0	5.0	6.8	7.1	8.6	8.2	8.1	**8.4**	4.2%	0.3%
South Korea	18.9	20.8	23.1	24.2	28.4	30.4	32.0	34.7	35.7	33.9	**42.9**	26.5%	1.4%
Taiwan	6.8	7.3	8.2	8.4	10.2	10.3	11.1	11.8	11.6	11.3	**14.1**	24.3%	0.4%
Thailand	22.0	24.8	26.9	28.6	29.9	32.5	33.3	35.4	37.4	39.2	**45.1**	15.0%	1.4%
Vietnam	1.6	2.0	2.4	2.4	4.2	6.4	7.0	7.1	7.5	8.0	**9.4**	16.7%	0.3%
Other Asia Pacific	3.9	3.8	3.6	4.2	4.5	5.2	5.5	6.0	5.7	5.2	**5.3**	3.6%	0.2%
Total Asia Pacific	290.8	308.0	324.6	350.8	367.7	398.9	426.0	459.6	484.0	503.9	**567.6**	12.6%	17.9%
Total World	**2411.7**	**2455.0**	**2520.3**	**2606.1**	**2694.5**	**2781.8**	**2842.4**	**2947.4**	**3026.4**	**2950.2**	**3169.0**	**7.4%**	**100.0%**
of which: OECD	1355.5	1340.1	1368.8	1392.4	1415.7	1422.5	1425.3	1475.9	1500.4	1453.0	**1546.2**	6.4%	48.9%
Non-OECD	1056.1	1114.9	1151.5	1213.7	1278.9	1359.2	1417.1	1471.5	1526.0	1497.2	**1622.8**	8.4%	51.1%
European Union	440.4	451.8	451.2	473.2	486.0	494.2	486.9	481.2	489.7	458.5	**492.5**	7.4%	15.5%
Former Soviet Union	523.6	541.6	547.8	565.9	583.9	594.4	604.7	619.0	613.1	558.9	**596.8**	6.8%	18.8%

†Less than 0.05.
♦Less than 0.05%.

Source: Includes data from Cedigaz.

Source: BP Statistical Review of World Energy, June 2011

Annex 9: Global Demands Outlook of gas as the Primary Energy by 2030 (bcm)

Region / Country	**2000**	**2006**	**2015**	**2030**	**Growth Average (%) 2006 - 2030**
OECD–North America	**799**	**766**	**848**	**908**	**7.0**
The US	669	611	652	631	**0.1**
OECD–Europe	478	541	614	694	**1.0**
OECD-Pacific	130	158	183	225	**1.5**
Japan	82	94	104	128	**1.3**
OECD	1407	1465	1645	1827	**0.9**
Eastern Europe & Eurasia	606	676	779	846	**0.9**
Russia	395	444	507	524	**0.7**
Asia	185	285	414	666	**3.6**
China	28	58	121	221	**5.8**
India	25	38	57	117	**4.8**
Middle East	182	276	378	676	**3.8**
Africa	62	90	124	168	**2.6**
Latin America	100	124	174	252	**3.0**
Brazil	9.0	21	32	46	**3.3**
Non-OECD	1135	1451	1867	2607	**2.5**
The World	2541	2916	3512	4434	**1.8**
The EU	**482**	**532**	**606**	**681**	**1.0**

source: by Author based on: IEA, World Energy Outlook, 2008; The Baker Institute World Gas Trade Model (BIWGTM)

Annex 10: Conversion Table of Volume

To:	NG (bcm)	NG (bcf)	Million tonnes of oil equivalent	Million tonnes of LNG	Trillion Btu	Million Barrels of oil equivalent
One bcm of NG	1	35.3	0.9	0.73	36	6.29
One bcf of NG	0.028	1	0.026	0.021	1.03	0.18
One Million tonnes of oil equivalent	1.111	39.2	1	0.805	40.4	7.33
One Million tonnes of LNG	1.38	48.7	1.23	1	52	8.68
One Trillion Btu	0.028	0.98	0.025	0.02	1	0.17
One Million barrels of oil equivalent	0.16	5.61	0.14	0.12	5.8	1

Source: By Author, based on G. Victor et al (2006) & IEA 2011, Key World Energy Statistics: 58

Annex 11: Global LNG liquefaction Plants and Regasification Terminals, as of May 2012

World's LNG Liquefaction Plants: Source: www.globallnginfo.com

On-Stream	Under Construction	Planned
Adgas LNG Plant (UAE)	Angola LNG Plant (Angola)	Abadi LNG Plant (Indonesia)
Algeria LNG Plants (Algeria)	Donggi-Senoro LNG Plant (Indonesia)	Arrow LNG Plant (Australia)
Arun LNG Plant (Indonesia)	Gladstone LNG Plant (Australia)	Australia Pacific LNG Plant (Australia)
Atlantic LNG Plant (Trinidad & Tobago)	Gorgon LNG Plant (Australia)	Baltic LNG Plant (Russia)
Bontang LNG Plants (Indonesia)	Iran (NIOC) LNG Plant (Iran) Suspended!	Bonaparte LNG Plant (Australia)
Brunei LNG Plant (Brunei)	Pluto LNG Plant (Australia)	Brass LNG Plant (Nigeria)
Damietta LNG Plant (Egypt)	PNG LNG Plant (Papua New Guinea)	Browse LNG Plant (Australia)
Darwin LNG Plant (Australia)	Queensland Curtis LNG Plant (Australia)	Delta Caribe LNG Plant (Venezuela) Suspended!
EG LNG Plant (Equatorial Guinea)	Wheatstone LNG Plant (Australia)	Fisherman's Landing LNG Plant (Australia)
Egyptian LNG Plant (Egypt)		Gulf LNG Plant (Papua New Guinea)
Kenai LNG Plant (Alaska, USA)		Ichthys LNG Plant (Australia)
Marsa El Brega LNG plant (Libya)		Kitimat LNG Plant (Canada)
MLNG Satu Plant (Malaysia)		Olokola LNG Plant (Nigeria)
MLNG Dua Plant (Malaysia)		Pars LNG Plant (Iran) Suspended!
MLNG Tiga Plant (Malaysia)		Persian LNG Plant (Iran) Suspended!
Nigerian LNG Plant (Nigeria)		Prelude LNG Plant (Australia)
Nordic (Skangass) LNG Plant (Norway)		Sabine Pass LNG Plant (USA)
North West Shelf LNG Plant (Australia)		Scarborough (Pilbara) LNG Plant (Australia)
Oman & Qalhat LNG Plant (Oman)		Shtokman LNG Plant (Russia)
Peru LNG Plant (Peru)		Sunrise LNG Plant (Australia)
Qatargas I LNG Plant (Qatar)		Yamal LNG Plant (Russia)
Qatargas II LNG Plant (Qatar)		
Qatargas III,IV LNG Plant (Qatar)		
RasGas I LNG Plant (Qatar)		
RasGas II LNG Plant (Qatar)		
Rasgas III LNG Plant (Qatar)		
Sakhalin LNG Plant (Russia)		
Snohvit LNG Plant (Norway)		

Tangguh LNG Plant (Indonesia)		
Yemen LNG Plant (Yemen)		

World's LNG Regasification Terminals: Source: www.globallnginfo.com

On-Stream:	*Under Construction:*	*Planned:*
Adriatic (Rovigo) LNG Terminal (Italy)	Bear Head LNG Terminal (Canada) Cancelled!	Adria LNG Terminal (Croatia)
Altamira LNG Terminal (Mexico)	Brindisi LNG Terminal (Italy) Cancelled!	Bahia LNG FSRU (TRBA) (Brazil)
Andres LNG Terminal (Dominican Rep.)	Dabhol LNG Terminal (India)	Bradwood Landing LNG Terminal (USA) Cancelled!
Bahia Blanca GasPort (Argentina)	Dunkirk LNG Terminal (France)	Boryeong LNG Terminal (S. Korea)
Barcelona LNG Terminal (Spain)	El Musel LNG Terminal (Spain)	Cacouna LNG Terminal (Canada) Suspended!
Bilbao LNG Terminal (Spain)	Hachinohe LNG terminal (Japan)	Calhoun LNG Terminal (USA) Suspended!
Brunnsviksholme LNG Terminal (Sweden)	Hainan LNG Terminal (China)	Canvey LNG Terminal (UK) Suspended!
Cameron LNG Terminal (USA)	Ishikari LNG terminal (Japan)	Casotte Landing LNG Terminal (USA) Cancelled!
Canaport LNG Terminal (Canada)	Jieyang (Yuedong) LNG Terminal (China)	Corpus Christi LNG Terminal (USA) Suspended!
Cartagena LNG Terminal (Spain)	Kita Kyushu LNG terminal (Japan)	Creole Trail LNG Terminal (USA) Cancelled!
Chita I,II,III LNG Terminals (Japan)	Kochi LNG Terminal (India)	Crown Landing LNG Terminal (USA) Cancelled!
Cove Point LNG Terminal (USA)	Livorno LNG Terminal (Italy)	East-Central Java LNG FSRU (Indonesia)
Dahej LNG Terminal (India)	Naoetsu LNG terminal (Japan)	Ennore LNG Terminal (India)
Dalian LNG Terminal (China)	Nusantara LNG FSRU (Indonesia)	Gioia Tauro (Medgas) LNG Terminal (Italy)
Dragon LNG Terminal (UK)	Samcheok LNG Terminal (S. Korea)	Goldboro LNG Terminal (Canada) Cancelled!
Elba Island LNG Terminal (USA)	Shandong LNG Terminal (China)	Hitachi LNG terminal (Japan)
Energia Costa Azul LNG Terminal (Mexico)	Singapore LNG Terminal (Singapore)	Ingleside Energy LNG Terminal (USA) Suspended!
Escobar GasPort (Argentina)	Swinoujscie LNG Terminal (Poland)	Jordan Cove LNG Terminal (USA)
Everett LNG Terminal (USA)	Tianjin (Hebei) LNG Terminal (China)	Kitimat LNG Terminal (Canada) Cancelled!
Fos Cavaou LNG Terminal (France)	Zhejiang Ningbo LNG Terminal (China)	Lampung LNG FSRU (Indonesia)
Fos Tonkin (Fos-Sur-Mer) LNG Terminal (France)	Zhuhai LNG Terminal (China)	Le Havre LNG Terminal (France) Suspended!
Freeport LNG Terminal (USA)		Levan (Falcione) LNG Terminal (Albania)
Fujian LNG Terminal (China)		LionGas LNG Terminal (Netherlands) Cancelled!
Fukuoka LNG Terminal (Japan)		Mangalore LNG Terminal (India) Suspended!
Futtsu LNG Terminal (Japan)		Mashal LNG Terminal (Pakistan)
Gate LNG Terminal (Netherlands)		Mundra LNG Terminal (India)
Golden Pass LNG Terminal (USA)		Oregon LNG Terminal (USA) Cancelled!
Guanabara LNG FSRU (Brazil)		Port Arthur LNG Terminal (USA) Cancelled!
Guangdong LNG Terminal (China)		Port Dolphin Deepwater LNG Port (USA)
Gulf Gateway GasPort (USA) decommissioned!		Porto Empedocle LNG Terminal (Italy)
Gulf LNG (Clean Energy) Terminal (USA)		Priolo (Augusta) LNG Terminal (Italy)
Gwangyang LNG Terminal (S. Korea)		Rabaska LNG Terminal (Canada)
Hatsukaichi LNG Terminal (Japan)		Rosignano LNG Terminal (Italy)
Hazira LNG Terminal (India)		SemanGas (ASG) LNG Terminal (Albania)
Higashi-ohgishima LNG Terminal (Japan)		Shannon LNG Terminal (S. Ireland)
Himeji I LNG Terminal (Japan)		Shin-Sendai LNG terminal (Japan)
Himeji II LNG Terminal (Japan)		Sonora LNG Terminal (Mexico)
Huelva LNG Terminal (Spain)		Sparrows Point LNG Terminal (USA)
Incheon LNG Terminal (S. Korea)		Tenerife LNG Terminal (Canary Isl.- Spain)
Isle of Grain LNG Terminal (UK)		Texada LNG Terminal (Canada) Suspended!
Izmir (Aliaga) LNG Terminal (Turkey)		Trieste LNG Terminal (Italy)
Jebel Ali (Dubai) LNG FSRU (UAE)		Vasiliko LNG Terminal (Cyprus) Suspended!
Jiangsu Rudong LNG Terminal (China)		Vista del Sol LNG Terminal (USA) Cancelled!
Joetsu LNG terminal (Japan)		Weaver's Cove LNG Terminal (USA) Cancelled!
Kagoshima LNG Terminal (Japan)		Wilhelmshaven LNG Terminal (Germany) Suspended!
Kawago LNG Terminal (Japan)		
Lake Charles LNG Terminal (USA)		
Manzanillo LNG Terminal (Mexico)		
Marmara LNG Terminal (Turkey)		
Mejillones LNG Terminal (Chile)		
Mina Al-Ahmadi GasPort (Kuwait)		
Mizushima LNG Terminal (Japan)		
Montoir-d-Bretagne LNG Terminal (France)		
Nagasaki Work LNG Terminal (Japan)		
Negishi LNG Terminal (Japan)		
Neptune Deepwater LNG Port (USA)		
Niigata LNG Terminal (Japan)		
Northeast Gateway GasPort (USA)		
Ohgishima LNG Terminal (Japan)		

Oita LNG Terminal (Japan) Panigaglia LNG Terminal (Italy) Pecem LNG FSRU (Brazil) Penuelas LNG Terminal (Puerto Rico) Pyeong Taek LNG Terminal (S. Korea) Quintero LNG Terminal (Chile) Rayong LNG Terminal (Thailand) Reganosa (EL Ferrol) LNG Terminal (Spain) Revithoussa LNG Terminal (Greece) Sabine Pass LNG Terminal (USA) Sagunto LNG Terminal (Spain) Sakai LNG Terminal (Japan) Sakaide LNG Terminal (Japan) Senbokui I,II LNG Terminal (Japan) Shanghai LNG Terminal (China) Shin Minato Works LNG Terminal (Japan) Sines LNG Terminal (Portugal) Sodeshi LNG Terminal (Japan) South Hook LNG Terminal (UK) Sudegaura LNG Terminal (Japan) Taichung LNG Terminal (Taiwan) Teesside GasPort (England) Tobata LNG Terminal (Japan) Tongyeong LNG Terminal (S. Korea) Yanai LNG Terminal (Japan) Yokkaichi LNG Terminal (Japan) Yokkaichi Works LNG Terminal (Japan) Yung An LNG Terminal (Taiwan) Zeebrugge LNG Terminal (Belgium)		

Source: globallnginfo.com

Annex 12: List of Recently Commissioned Liquefaction Plants

Country	Project Name	Start Year	Nameplate Capacity (MMtpa)	Project Partners	Liquefaction Technology
Trinidad	ALNG T4	2006	5.2	BG, BP, NGC Trinidad, Repsol	Optimized Cascade
Nigeria	NLNG T4	2006	4.1	Eni, NNPC, Shell, TOTAL	APC C3MR
Nigeria	NLNG T5	2006	4.1	Eni, NNPC, Shell, TOTAL	APC C3MR
Oman	Qalhat LNG	2006	3.7	Shell, TOTAL, Itochu, Korea LNG, Mitsubishi, Mitsui, Omani Government, Osaka Gas, Partex, Petroleum Development Oman (PDO), Union Fenosa Gas	APC C3MR
Australia	Darwin LNG T1	2006	3.6	ConocoPhillips, Eni, INPEX, Santos, TEPCO, Tokyo Gas,	Optimized Cascade
Equatorial Guinea	EG LNG T1	2007	3.7	GE Petrol, Marathon, Marubeni, Mistui,	Optimized Cascade
Norway	Snøhvit LNG T1	2007	4.2	TOTAL, GDF SUEZ, Hess, Petoro, RWE, Statoil	Linde MFC
Qatar	RasGas II (T3)	2007	4.7	ExxonMobil, Qatar Petroleum	APC C3MR/ Split MR
Nigeria	NLNG T6	2008	4.1	Eni, NNPC, Shell, TOTAL	APC C3MR
Australia	North West Shelf T5	2008	4.4	BP, Chevron, Shell, BHP Billiton, Mitsubishi, Mitsui, Woodside	APC C3MR
Qatar	Qatargas II (T1)	2009	7.8	ExxonMobil, Qatar Petroleum	APC AP-X
Qatar	Qatargas II (T2)	2009	7.8	ExxonMobil, Qatar Petroleum, TOTAL	APC AP-X
Qatar	RasGas III (T1)	2009	7.8	ExxonMobil, Qatar Petroleum	APC AP-X
Yemen	Yemen LNG T1	2009	3.4	TOTAL, GASSP, Hunt Oil, Hyundai, KOGAS, SK Corp, Yemen Gas	APC C3MR/ Split MR
Indonesia	Tangguh LNG T1	2009	3.8	BP, CNOOC, INPEX, JX Nippon Oil & Energy, KG Berau, LNG Japan, Mitsubishi, Mitsui, Talisman	APC C3MR/ Split MR
Indonesia	Tangguh LNG T2	2009	3.8	BP, CNOOC, INPEX, JX Nippon Oil & Energy, KG Berau, LNG Japan, Mitsubishi, Mitsui, Talisman	APC C3MR/ Split MR
Russia	Sakhalin 2 (T1)	2009	4.8	Shell, Gazprom, Mitsubishi, Mitsui	Shell DMR
Russia	Sakhalin 2 (T2)	2009	4.8	Shell, Gazprom, Mitsubishi, Mitsui	Shell DMR
Qatar	Qatargas III	2010	7.8	ConocoPhillips, Qatar Petroleum, Mitsui	APC AP-X
Qatar	RasGas III (T2)	2010	7.8	ExxonMobil, Qatar Petroleum	APC AP-X
Yemen	Yemen LNG T2	2010	3.4	TOTAL, GASSP, Hunt Oil, Hyundai, KOGAS, SK Corp, Yemen Gas	APC C3MR/ Split MR
Peru	Peru LNG	2010	4.5	Hunt Oil, Marubeni, SK Corp, Repsol	APC C3MR/ Split MR
Qatar	Qatargas IV	2011	7.8	Qatar Petroleum, Shell	APC AP-X

Source: IGU World LNG Report 2010: 36

Annex 13: List of Under Construction Liquefaction Plants

Country	Project	Announced Start Year	Nameplate Capacity (MMtpa)	Project Partners
Australia	Pluto LNG T1	2011	4.8	Kansai Electric, Tokyo Gas, Woodside
Algeria	Arzew GL3Z (Gassi Touil)	2012	4.7	Sonatrach
Angola	Angola LNG T1	2012	5.2	BP, Chevron, Eni, Sonangol, TOTAL
Algeria	Skikda GL1K Rebuild	2013	4.5	Sonatrach
Australia	Queensland Curtis LNG T1	2014	4.25	BG, CNOOC
Australia	Gorgon LNG T1	2014	5	Chevron, Chubu Electric, ExxonMobil, Osaka Gas, Shell, Tokyo Gas
Australia	Gorgon LNG T2	2014	5	Chevron, Chubu Electric, ExxonMobil, Osaka Gas, Shell, Tokyo Gas
Indonesia	Donggi-Senoro LNG	2014	2	KOGAS, Medco, Mitsubishi, Pertamina
Papua New Guinea	PNG LNG T1	2014	3.3	ExxonMobil, JX Nippon Oil & Energy, Mitsubishi, MRDC, Oil Search, Petromin, PNG Government, Santos
Papua New Guinea	PNG LNG T2	2014	3.3	ExxonMobil, JX Nippon Oil & Energy, Mitsubishi, MRDC, Oil Search, Petromin, PNG Government, Santos
Australia	Gladstone LNG T1	2015	3.9	KOGAS, Santos, PETRONAS, TOTAL
Australia	Gladstone LNG T2	2015	3.9	KOGAS, Santos, PETRONAS, TOTAL
Australia	Queensland Curtis LNG T2	2015	4.25	BG, Tokyo Gas
Australia	Gorgon LNG T3	2015	5	Chevron, Chubu Electric, ExxonMobil, Osaka Gas, Shell, Tokyo Gas

Source: IGU World LNG Report 2010: 37

Annex 14: List of Recently Commissioned LNG Regasification Terminals

Country	Project*	Announced Start Year	Nameplate Capacity (MMtpa)	Project Partners
Argentina	Bahía Blanca GasPort (OS)	2008	3.0	Excelerate
Belgium	Zeebrugge (Expansion)	2008	3.3	Fluxys
Brazil	Guanabara LNG (Rio de Janeiro) (OS)	2009	3.7	Petrobras
Brazil	Pecem (OS)	2009	1.9	Petrobras
Canada	Canaport	2009	7.5	Irving Oil, Repsol YPF
Chile	Quintero LNG	2009	2.5	BG, Enap, Endesa, Metrogas
Chile	Mejillones LNG (Phase 1)	2010	1.5	Codelco, GDF SUEZ
China	Dapeng LNG	2006	3.7	CNOOC, BP
China	Fujian LNG	2008	2.6	CNOOC, Fujian Investment & Development Co
China	Mengtougou Peak Shaving Terminal	2008	0.1	Shanghai Gas Group
China	Dapeng LNG (Expansion)	2009	3.0	CNOOC
China	Shanghai LNG (Yangshan)	2009	3.0	CNOOC
France	Fos Cavaou	2010	6.0	GDF SUEZ, TOTAL
Greece	Revithoussa (Expansion)	2007	2.7	DEPA
India	Hazira LNG (Debottlenecking)	2008	1.1	Shell, TOTAL
India	Dahej LNG (Expansion)	2009	3.5	Petronet LNG
Italy	Adriatic LNG/Rovigo (OS)	2009	5.8	Edison, ExxonMobil, Qatar Petroleum
Japan	Mizushima LNG	2006	0.6	Mizushima LNG (Chugoku Electric, JX Nippon Oil & Energy)
Japan	Sodegaura (Expansion)	2008	1.6	Tokyo Gas, TEPCO
Japan	Sakaide	2010	0.7	Cosmo Gas, Shikoku Electric, Shikoku Gas
Kuwait	Mina Al-Ahmadi GasPort (OS)	2009	3.8	Excelerate
Mexico	Altamira LNG	2006	4.9	Mitsui & Co, Shell, Total
Mexico	Costa Azul	2008	7.5	Sempra
Spain	Cartagena (Expansion)	2006	1.9	ENAGAS
Spain	Huelva (Expansion)	2006	2.7	ENAGAS
Spain	Sagunto	2006	4.8	Banco Pastor, Caixa Galicia, Caixanova, Gas Natural Fenosa, Sonatrach, Tojeiro Group, Union Fenosa Gas, Xunta de Galicia
Spain	Mugardos LNG (El Ferrol)	2007	2.6	ENAGAS
Spain	Sagunto (Expansion)	2009	1.5	Banco Pastor, Caixa Galicia, Caixanova, Gas Natural Fenosa, Sonatrach, Tojeiro Group, Union Fenosa Gas, Xunta de Galicia
Spain	Barcelona (Expansion)	2010	4.7	ENAGAS
Taiwan	Taichung LNG	2009	3.0	CPC
Turkey	Aliaga LNG	2006	4.4	Egegaz
UAE	Dubai (OS)	2010	3.0	Golar LNG
UK	Teesside GasPort	2007	3.0	Excelerate
UK	Grain LNG (Phase 2)	2008	6.5	National Grid Transco
UK	Dragon LNG	2009	4.4	4Gas, BG, PETRONAS
UK	South Hook (Phase 1)	2009	7.8	ExxonMobil, Qatar Petroleum, TOTAL
UK	Grain LNG (Phase 3)	2010	5.2	National Grid Transco
UK	South Hook (Phase 2)	2010	7.8	ExxonMobil, Qatar Petroleum, TOTAL
US	Elba Island II	2006	3.3	El Paso
US	Lake Charles (Expansion Ph. 2)	2006	4.4	AIG Highstar, Southern Union
US	Freeport LNG	2008	11.3	Dow Chemical, Michael S Smith Cos, Osaka Gas, ZHA FLNG Purchaser
US	Northeast Gateway (OS)	2008	3.0	Excelerate
US	Sabine Pass	2008	19.6	Cheniere Energy
US	Cameron LNG	2009	11.3	Sempra
US	Cove Point (Expansion)	2009	5.5	Dominion
US	Sabine Pass (Expansion)	2009	10.6	Cheniere Energy
US	Elba Island III (Phase 1)	2010	3.5	El Paso
US	Lake Charles (IEP)	2010	3.9	AIG Highstar, Southern Union
US	Neptune LNG (OS)	2010	3.0	GDF SUEZ

Source: IGU World LNG Report 2010: 38-39

Annex 15: List of Under Construction LNG Regasification Terminals

Country	Project*	Announced Start Year	Nameplate Capacity (MMtpa)	Project Partners
Argentina	Puerto Escobar (OS)	2011	3.8	Excelerate
China	Dalian	2011	3.0	Dalian Construction Investment Corp, Dalian Port, Kunlun Energy
China	Fujian LNG (Expansion)	2011	2.6	CNOOC, Fujian Investment & Development Co
China	Rudong/Jiangsu LNG	2011	3.5	Jiangsu Guoxin, Pacific Oil, Kunlun Energy
China	Zhuhai	2012	3.5	CNOOC, Guangdong Yuedian Group
China	Ningbo, Zhejiang	2013	3.0	CNOOC, Ningbo Power Development Co Ltd, Zhejiang Energy Group Co Ltd
India	Dabhol LNG	2011	2.0	GAIL, NTPC
India	Kochi LNG	2012	3.0	Petronet LNG
Indonesia	Khannur FSRU (West Java) (OS)	2012	3.0	Nusantara Regas (Pertamina, PGN)
Italy	Livorno (OS)	2012	2.7	EON, Golar LNG, IRIDE, OLT Energy
Japan	Ohgishima (Expansion)	2011	1.6	Tokyo Gas
Japan	Ishikari LNG	2012	1.4	Hokkaido Gas
Japan	Mizushima LNG (Expansion)	2012	0.9	Mizushima LNG (Chugoku Electric, JX Nippon Oil & Energy)
Japan	Hibiki LNG	2014	3.5	Kyushu Electric, Saibu Gas
Japan	Naoetsu	2014	1.5	Inpex Corp
Korea	Samcheok	2015	6.8	KOGAS
Malaysia	Lekas LNG (Malacca)	2012	3.8	PETRONAS
Mexico	Manzanillo	2011	3.8	KOGAS, Mitsui, Samsung
Netherlands	Gate LNG	2011	8.8	Dong, EconGas OMV, EON, Gasunie, RWE, Vopak
Poland	Swinoujscie	2014	3.6	GAZ-SYSTEM SA
Portugal	Sines LNG (Expansion Phase 1)	2012	3.4	REN
Singapore	Jurong Island LNG	2013/2014	3.5/6.0	Singapore Energy Market Authority
Spain	El Musel (Gijon)	2012	5.8	ENAGAS
Sweden	Nynashamn LNG	2011	0.3	AGA Gas AB
Thailand	Rayong	2011	5.0	Electricity Generating Authority of Thailand. Electricity Generating Company, PTT
US	Clean Energy Terminal	2011	11.3	El Paso, GE Energy Financial Services, Sonagol
US	Golden Pass (Phase 2)	2011	12.8	ConocoPhillips, ExxonMobil, Qatar Petroleum

Source: IGU World LNG Report 2010:40

Annex 16: Global gas production by country, region and continent, 2000-2040 (tcf)

Region/Country	2000	2006	2010	2016	2020	2026	2030	2036	2040
Africa	5.87	8.31	9.65	12.70	14.53	16.69	16.79	16.23	14.86
Algeria	3.70	4.36	4.61	4.81	4.55	3.80	3.12	2.35	2.04
Angola	0.03	0.08	0.11	0.16	0.36	0.85	0.91	0.90	0.90
East Africa	0.00	0.00	0.03	0.10	0.13	0.17	0.21	0.44	0.47
Egypt	1.06	1.37	1.57	2.04	2.30	2.67	2.88	3.15	3.14
Libya	0.26	0.94	1.28	1.63	1.71	1.81	1.76	1.34	1.11
Morocco	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nigeria	0.61	1.04	1.30	2.54	3.68	5.31	5.93	6.24	5.73
South Africa	0.07	0.10	0.06	0.06	0.08	0.12	0.09	0.12	0.11
Tunisia	0.11	0.18	0.22	0.24	0.26	0.35	0.29	0.21	0.18
West Africa	0.00	0.03	0.10	0.19	0.27	0.27	0.28	0.27	0.21
Asia - Pacific	11.63	16.08	18.43	21.80	24.57	28.37	29.92	28.96	26.80
Afghanistan	0.00	0.01	0.18	0.31	0.41	0.56	0.57	0.58	0.45
Australia	1.37	2.14	2.09	2.69	3.85	6.87	8.64	9.87	10.10
Bangladesh	0.38	0.71	1.07	1.23	1.24	1.14	0.96	0.65	0.51
Brunei	0.45	0.49	0.52	0.60	0.72	0.88	0.95	0.79	0.64
China	1.29	2.29	2.70	2.97	2.94	3.10	3.16	3.04	2.81
Hong Kong	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
India	1.02	1.32	1.55	1.94	2.02	1.76	1.39	1.04	0.80
Indonesia	2.94	3.29	3.48	4.05	4.78	5.95	6.69	6.99	6.59

Japan	0.09	0.08	0.06	0.06	0.06	0.03	0.02	0.01	0.01
Malaysia	1.98	2.61	2.84	3.14	3.24	3.28	3.16	2.56	2.07
Myanmar	0.25	0.42	0.70	0.95	1.01	1.02	0.94	0.62	0.49
New Zealand	0. 18	0.25	0.24	0.22	0.16	0.10	0.07	0.06	0.04
Pakistan	0.84	1.10	1.52	1.86	1.91	1.30	0.95	0.64	0.52
Papua New Guinea	0.00	0.00	0.20	0.64	1.00	1.18	1.25	1.07	0.86
The Philippines	0.07	0.13	0.15	0.25	0.47	0.65	0.70	0.73	0.63
Singapore	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Korea, South	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Taiwan	0.09	0.10	0.07	0.04	0.03	0.03	0.03	0.02	0.02
Thailand	0.57	0.77	0.69	0.58	0.53	0.39	0.32	0.22	0.19
Vietnam/Laos/ Cambodia	0.10	0.36	0.36	0.28	0.19	0.12	0.10	0.07	0.07
Europe	11.99	14.46	13.22	11.21	9.74	8.33	8.77	9.85	10.07
Austria	0.07	0.07	0.05	0.03	0.02	0.01	0.01	0.01	0.00
Balkan Region	0.19	0.31	0.26	0.17	0.12	0.07	0.05	0.4	0.03
Belgium/ Luxembourg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bulgaria	0.03	0.07	0.03	0.02	0.01	0.01	0.01	0.01	0.01
Czech Republic	0.06	0.07	0.05	0.03	0.02	0.01	0.01	0.01	0.01
Denmark/	0.19	0.23	0.21	0.14	0.10	0.09	0.37	1.49	2.33

Greenland									
Finland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
France	0.07	0.08	0.06	0.04	0.05	0.19	0.41	0.52	0.40
Germany	0.77	1.01	0.95	0.91	0.83	0.60	0.46	0.28	0.19
Region/Country	2000	2006	2010	2016	2020	2026	2030	2036	2040
Greece	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hungary	0.23	0.31	0.21	0.12	0.09	0.05	0.04	0.03	0.02
Ireland	0.03	0.06	0.04	0.02	0.02	0.01	0.01	0.01	0.00
Italy	0.81	1.00	0.80	0.76	0.67	0.43	0.30	0.18	0.20
The Netherlands	2.77	3.25	3.17	2.63	2.07	1.33	0.97	0.58	0.45
Norway	2.27	2.67	2.75	3.01	3.12	3.69	4.56	5.41	5.32
Poland	0.33	0.50	0.38	0.21	0.15	0.09	0.07	0.05	0.04
Portugal	0.00	0.00v	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Romania	0.73	0.99	0.85	0.54	0.37	0.23	0.18	0.12	0.10
Slovakia	0.04	0.04	0.03	0.02	0.02	0.01	0.01	0.00	0.00
Spain	0.01	0.01	0.00	0.00	0.01	0.01	0.11	0.40	0.45
Sweden	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Switzerland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
The United Kingdom	3.38	3.81	3.37	2.56	2.08	1.51	1.22	0.73	0.51
FSU	28.54	31.87	34.67	38.70	42.10	47.56	52.03	56.78	38.26
Armenia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

R. Azerbaijan	0.34	0.78	0.93	1.01	1.13	1.62	2.12	2.67	2.78
Belarus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Estonia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Georgia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kazakhstan	1.21	2.89	3.51	3.65	3.54	3.17	2.93	2.44	2.10
Kirgizstan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Latvia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lithuania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Moldova	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Russia	22.87	23.46	25.16	28.42	31.15	35.80	39.68	44.48	46.01
Tajikistan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Turkmenistan	1.63	1.65	1.70	1.94	2.37	3.24	3.84	4.84	5.56
Ukraine	0.69	1.25	1.51	1.80	2.00	1.85	1.63	1.00	0.80
Uzbekistan	1.81	1.85	1.87	1.88	1.90	1.88	1.83	1.36	1.01
The Middle East	8.95	10.81	12.46	16.06	19.80	28.55	35.81	47.47	52.11
Bahrain	0.33	0.32	0.24	0.17	0.19	0.43	0.52	0.49	0.39
I.R. Iran	2.68	2.67	2.64	3.04	3.79	5.93	8.34	13.01	15.62
Iraq	0.07	0.76	1.65	2.93	3.73	4.73	5.14	5.39	5.26
Kuwait	0.35	0.38	0.89	1.50	1.66	1.70	1.70	1.69	1.50
Oman	0.43	0.29	0.22	0.44	0.67	1.02	1.09	1.30	1.40
Qatar	1.19	1.39	1.61	2.12	2.78	4.92	6.48	8.53	9.39
Saudi Arabia	2.24	2.60	2.67	3.22	4.06	6.07	7.94	10.97	12.16

Syria/ Jordan	0.20	0.60	0.60	0.43	0.30	0.18	0.15	0.11	0.10
Turkey	0.03	0.09	0.06	0.02	0.02	0.02	0.01	0.01	0.01
The UAE	1.43	1.65	1.73	1.92	2.13	2.70	3.47	5.00	5.26
Yemen	0.00	0.06	0.14	0.27	0.46	0.86	0.97	0.96	1.01
North America	28.04	32.48	29.97	28.33	26.05	22.64	20.14	16.41	15.03
Canada	6.44	6.65	6.56	6.42	5.97	5.42	4.74	3.95	3.85
Mexico	1.24	1.41	1.00	0.89	1.01	1.04	1.01	0.67	0.53
The USA	20.36	24.42	22.41	21.02	19.07	16.17	14.39	11.80	10.66
Central & South America	4.19	5.72	6.88	8.52	9.95	12.03	13.01	12.78	12.43
Argentina	1.28	1.48	1.52	1.55	1.51	1.53	1.50	1.10	0.89
Bolivia	0.18	0.50	0.58	0.72	0.77	0.98	1.03	0.95	0.85
Brazil	0.38	0.38	0.46	0.71	0.98	1.14	1.37	1.87	2.30
Central America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chile	0.11	0.24	0.25	0.23	0.26	0.26	0.23	0.16	0.14
Colombia	0.24	0.33	0.92	1.23	1.26	1.22	1.16	0.89	0.71
Cuba	0.02	0.04	0.07	0.07	0.05	0.03	0.03	0.02	0.02
Ecuador	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.04
Paraguay	0.00	0.07	0.09	0.07	0.06	0.05	0.04	0.03	0.02
Peru	0.01	0.04	0.06	0.22	0.42	0.57	0.65	0.79	0.79
Suriname/ Guinea	0.00	0.07	0.23	0.47	0.63	0.73	0.74	0.72	0.54
Trinidad &	0.75	1.24	1.35	1.45	1.56	1.61	1.51	1.05	0.93

Tobago									
Uruguay	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venezuela	1.22	1.31	1.35	1.80	2.43	3.90	4.74	5.18	5.21
The World	99.22	119.73	125.29	137.31	146.72	146.17	176.47	188.48	189.55

Source: By Author, on the basis of: G. Victor et al, Natural Gas and Geopolitics, from 1970-2040, Cambridge University Press, the UK, Part 3, chapter 11: 357-407.

Annex 17: Global gas demand by country, region and continent, 2000-2040 (tcf)

Region/Country	2000	2006	2010	2016	2020	2026	2030	2036	2040
Africa	2.65	3.35	3.65	4.33	4.81	5.56	6.08	6.83	6.95
Algeria	0.82	0.89	0.95	1.11	1.23	1.45	1.60	1.84	1.77
Angola	0.03	0.05	0.06	0.07	0.09	0.11	0.12	0.14	0.16
East Africa	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Egypt	1.05	1.33	1.47	1.71	1.88	2.16	1.37	2.70	2.82
Libya	0.24	0.30	0.33	0.38	0.42	0.49	0.53	0.57	0.56
Morocco	0.02	0.05	0.06	0.07	0.08	0.09	0.09	0.09	0.09
Nigeria	0.22	0.27	0.29	0.37	0.42	0.51	0.58	0.68	0.74
South Africa	0.07	0.14	0.16	0.16	0.15	0.15	0.13	0.12	0.10
Tunisia	0.16	0.21	0.24	0.29	0.33	0.39	0.43	0.45	0.47
West Africa	0.00	0.03	0.07	0.10	0.12	0.13	0.13	0.13	0.12
Asia - Pacific	12.22	16.19	18.27	21.69	24.23	28.28	30.42	31.92	31.94
Afghanistan	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03
Australia	0.96	1.33	1.44	1.63	1.79	1.99	2.11	2.27	2.35
Bangladesh	0.37	0.49	0.56	0.66	0.72	0.82	0.87	0.91	0.93
Brunei	0.07	0.08	0.08	0.09	0.09	0.09	0.10	0.11	0.11
China	1.33	2.18	2.69	3.68	4.49	5.83	6.48	6.93	7.13
Hong Kong	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.02	0.02
India	0.97	1.49	2.31	2.97	3.38	3.99	4.30	4.56	4.58
Indonesia	1.31	1.63	1.74	1.92	2.04	2.22	2.33	2.31	2.23

Japan	2.71	2.73	2.49	3.61	2.80	3.25	3.54	3.74	3.71
Malaysia	1.09	1.35	1.48	1.70	1.85	2.10	2.25	2.29	2.25
Myanmar	0.08	0.11	0.13	0.15	0.16	0.18	0.19	0.19	0.19
New Zealand	0.18	0.23	0.24	0.25	0.26	0.27	0.28	0.25	0.24
Pakistan	0.83	1.08	1.19	1.39	1.53	1.76	1.95	2.25	2.17
Papua New Guinea	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
The Philippines	0.07	0.12	0.14	0.17	0.20	0.23	0.26	0.28	0.29
Singapore	0.04	0.09	0.10	0.12	0.13	0.14	0.15	0.13	0.12
Korea, South	0.88	1.17	1.25	1.53	1.74	2.03	2.20	2.25	2.25
Taiwan	0.30	0.53	0.60	0.69	0.73	0.76	0.76	0.73	0.70
Thailand	0.89	1.18	1.27	1.37	1.42	1.49	1.46	1.43	1.40
Vietnam/Laos/ Cambodia	0.10	0.35	0.51	0.72	0.85	1.05	1.14	1.23	1.24
Europe	18.65	22.01	22.34	23.77	24.90	26.35	27.17	27.86	27.46
Austria	0.31	0.36	0.36	0.39	0.41	0.43	0.44	0.46	0.46
Balkan Region	0.18	0.26	0.27	0.28	0.30	0.31	0.31	0.29	0.28
Belgium/ Luxembourg	0.66	0.75	0.74	0.77	0.79	0.82	0.84	0.88	0.87
Bulgaria	0.19	0.17	0.15	0.15	0.16	0.18	0.19	0.19	0.19
Czech Republic	0.35	0.38	0.36	0.38	0.40	0.42	0.44	0.47	0.48
Denmark/	0.21	0.27	0.28	0.30	0.31	0.32	0.33	0.33	0.33

Greenland									
Finland	0.18	0.23	0.23	0.25	0.27	0.31	0.33	0.32	0.32
France	1.77	1.89	2.06	2.15	2.23	2.39	2.54	2.72	2.72
Germany	3.31	3.72	3.61	3.72	3.84	4.00	4.12	4.25	4.22
Region/Country	2000	2006	2010	2016	2020	2026	2030	2036	2040
Greece	0.08	0.13	0.14	0.17	0.20	0.25	0.28	0.28	0.28
Hungary	0.49	0.57	0.60	0.68	0.75	0.83	0.86	0.88	0.87
Ireland	0.17	0.25	0.28	0.30	0.30	0.32	0.33	0.34	0.34
Italy	2.60	2.86	2.89	3.11	3.28	3.47	3.55	3.60	3.54
The Netherlands	1.64	1.87	1.92	2.03	2.11	2.16	2.21	2.25	2.20
Norway	0.29	0.40	0.42	0.45	0.48	0.50	0.51	0.53	0.53
Poland	0.49	0.63	0.64	0.70	0.76	0.85	0.87	0.88	0.86
Portugal	0.12	0.24	0.29	0.34	0.37	0.39	0.40	0.40	0.40
Romania	0.68	0.68	0.67	0.73	0.80	0.91	0.94	0.97	0.96
Slovakia	0.28	0.31	0.31	0.32	0.33	0.34	0.34	0.34	0.33
Spain	0.85	1.43	1.64	1.91	2.06	2.21	2.24	2.28	2.26
Sweden	0.04	0.06	0.05	0.05	0.05	0.05	0.05	0.06	0.06
Switzerland	0.12	0.15	0.14	0.14	0.14	0.15	0.16	0.17	0.17
The United Kingdom	3.67	4.21	4.29	4.45	4.57	4.75	4.90	4.99	4.81
FSU	22.34	26.70	28.52	31.24	33.12	35.89	37.50	38.26	37.33
Armenia	0.04	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.06

R. Azerbaijan	0.35	0.54	0.64	0.77	0.85	0.97	1.05	1.17	1.18
Belarus	0.64	0.74	0.76	0.78	0.80	0.84	0.85	0.81	0.78
Estonia	0.05	0.08	0.09	0.11	0.12	0.14	0.15	0.15	0.15
Georgia	0.05	0.09	0.11	0.13	0.15	0.16	0.17	0.18	0.17
Kazakhstan	0.59	0.75	0.80	0.89	0.97	1.09	1.16	1.26	1.32
Kirgizstan	0.08	0.12	0.15	0.19	0.21	0.25	0.28	0.29	0.29
Latvia	0.06	0.08	0.08	0.09	0.10	0.12	0.12	0.12	0.12
Lithuania	0.11	0.13	0.13	0.14	0.15	0.17	0.17	0.17	0.17
Moldova	0.08	0.11	0.12	0.13	0.14	0.14	0.14	0.14	0.13
Russia	15.10	18.04	19.31	21.12	22.32	24.05	25.10	25.26	24.31
Tajikistan	0.05	0.06	0.06	0.06	0.07	0.07	0.08	0.08	0.08
Turkmenistan	0.43	0.56	0.64	0.75	0.83	0.95	1.03	1.17	1.26
Ukraine	3.01	3.52	3.63	3.85	4.01	4.26	4.29	4.22	4.12
Uzbekistan	1.70	1.83	1.94	2.16	2.33	2.62	2.83	3.17	3.18
The Middle East	8.94	10.20	10.63	11.81	12.88	14.69	16.01	17.93	18.93
Bahrain	0.34	0.36	0.38	0.42	0.46	0.53	0.58	0.65	0.63
I.R. Iran	3.06	3.18	3.22	3.67	4.13	4.39	5.53	6.45	7.05
Iraq	0.06	0.11	0.12	0.19	0.26	0.39	0.50	0.66	0.76
Kuwait	0.33	0.37	0.37	0.38	0.41	0.46	0.50	0.56	0.60
Oman	0.24	0.30	0.34	0.39	0.43	0.49	0.54	0.60	0.65
Qatar	0.41	0.45	0.46	0.47	0.48	0.50	0.51	0.53	0.54
Saudi Arabia	2.17	2.56	2.67	2.91	3.11	3.44	3.69	4.06	4.31
Syria/ Jordan	0.20	0.28	0.26	0.28	0.31	0.36	0.39	0.45	0.48

Turkey	0.68	0.96	1.07	1.27	1.43	1.67	1.84	2.01	1.95
The UAE	1.34	1.64	1.72	1.79	1.82	1.86	1.87	1.87	1.88
Yemen	0.00	0.00	0.02	0.04	0.05	0.06	0.07	0.07	0.08
North America	27.68	32.58	31.95	32.38	33.16	36.42	38.91	41.35	40.93
Canada	3.08	3.88	3.97	4.15	4.27	4.55	4.77	4.92	4.82
Mexico	1.61	2.03	2.15	2.47	2.70	3.08	3.37	3.74	3.87
The USA	22.99	26.67	25.83	25.76	26.19	28.79	30.78	32.69	32.24
Central & South America	3.79	4.83	5.28	6.09	6.68	7.64	8.18	8.88	9.22
Argentina	1.09	1.28	1.39	1.62	1.79	2.06	2.20	2.37	2.42
Bolivia	0.04	0.06	0.08	0.09	0.10	0.12	0.13	0.14	0.14
Brazil	0.50	0.92	1.08	1.34	1.50	1.79	1.95	2.20	2.35
Central America	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Chile	0.25	0.34	0.37	0.39	0.41	0.44	0.44	0.46	0.46
Colombia	0.19	0.27	0.30	0.33	0.36	0.39	0.42	0.43	0.38
Cuba	0.01	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02
Ecuador	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Paraguay	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Peru	0.01	0.03	0.04	0.06	0.07	0.08	0.09	0.10	0.11
Suriname/ Guinea	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.3	0.03
Trinidad & Tobago	0.44	0.53	0.61	0.71	0.78	0.89	0.97	1.00	1.02
Uruguay	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Venezuela	1.23	1.31	1.32	1.43	1.55	1.72	1.84	2.03	2.17
The World	96.18	115.86	120.67	131.32	139.78	154.83	164.28	173.02	172.74

Source: By Author, on the basis of: G. Victor et al, Natural Gas and Geopolitics, from 1970-2040, Cambridge University Press, the UK, Part 3, chapter 11: 357- 407.

Annex 18: International Country Risk Guide's (ICRG) Methodology

POLITICAL RISK COMPONENTS

Sequence	**Component**	**Points (max.)**
A	Government Stability	12
B	Socioeconomic Conditions	12
C	Investment Profile	12
D	Internal Conflict	12
E	External Conflict	12
F	Corruption	6
G	Military in Politics	6
H	Religious Tensions	6
I	Law and Order	6
J	Ethnic Tensions	6
K	Democratic Accountability	6
L	Bureaucracy Quality	4
Total		100

Political Risk Points By Component	• Government Stability • Socioeconomic Conditions • Investment Profile • Internal Conflict • External Conflict • Corruption • Military in Politics • Religious Tensions • Law and Order • Ethnic Tensions • Democratic Accountability • Bureaucracy Quality

Summary of Economic Risk Components	• GDP Per Capita • Real Annual GDP Growth as Annual % Change • Annual Inflation Rate as Annual % Change • Budget Balance as % of GDP • Current Account as % of GDP
Summary of Financial Risk Components	• Foreign Debt as % of GDP • Foreign Debt Service as % of Exports of Goods and Services • Current Account as % of Exports of Goods and Services • International Liquidity as Months of Import Cover • Exchange Rate Stability as % Change
GDP Per Head of Population	• Current and Preceding 5 Years • % of Average • Current Risk Points

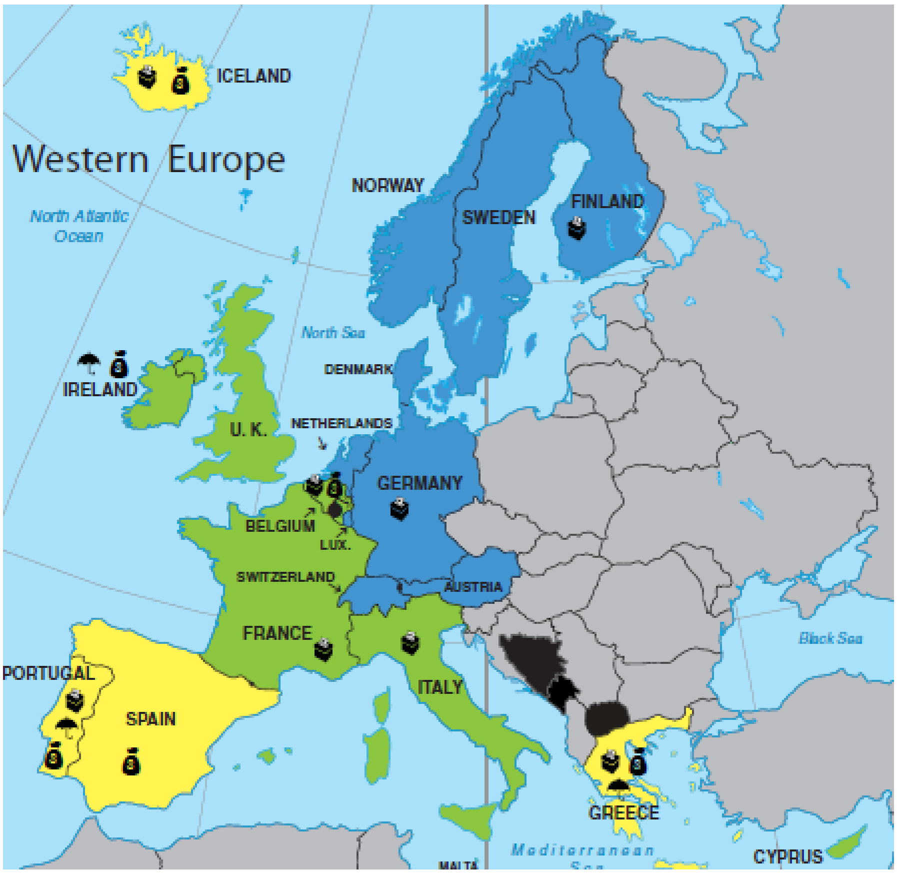
CPFER = Composite political, financial and economic risk ratings

Very High Risk	00.0 to 49.9 points
High Risk	50.0 to 59.9 points
Moderate Risk	60.0 to 69.9 points
Low Risk	70.0 to 79.9 points
Very Low Risk	80.0 to 100 points

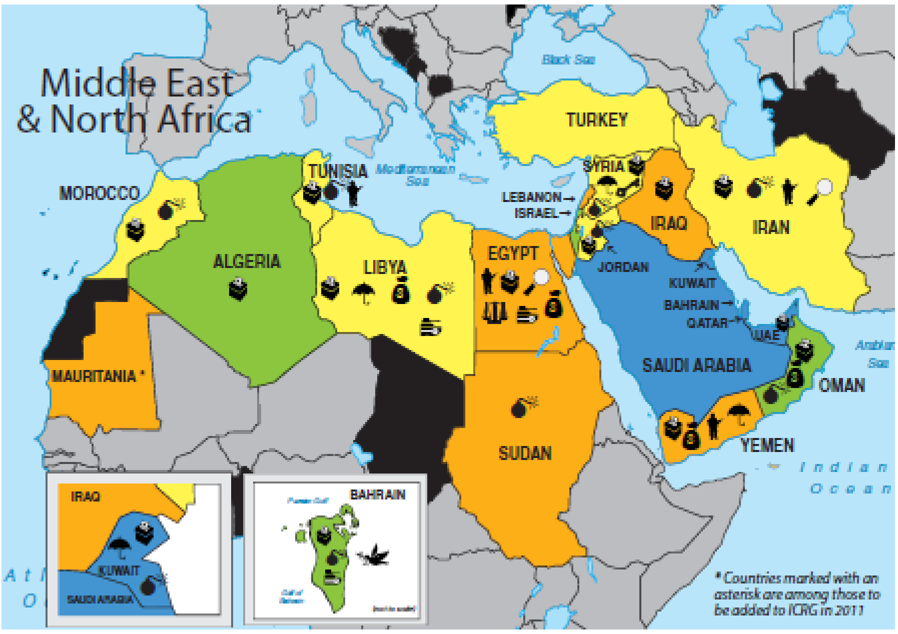
Annex 19: Global Investment and Political Risk by country, region and continent, 2011

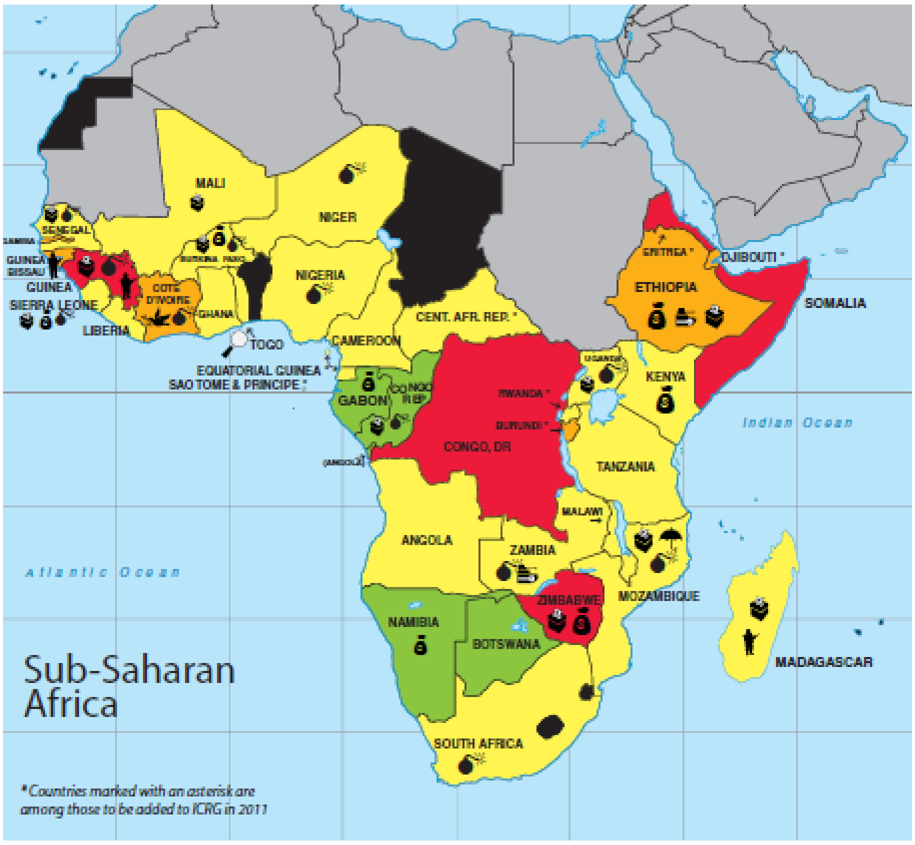

The Americas
U.S.
Gulf of Mexico
CUBA
BAHAMAS
DOM. REP.
JAMAICA
HAITI
MEX.
HONDURAS
Caribbean Sea
TRINIDAD AND TOBAGO
GUATEMALA
EL SALVADOR
NICARAGUA
COSTA RICA
PANAMA
VENEZUELA
GUYANA
COLOMBIA
BRAZ.


TRIN. & TOB.
Caribbean Sea
COSTA RICA
PANAMA
VENEZUELA
GUYANA
SURINAME
COLOMBIA
ECUADOR
BRAZIL
PERU
BOLIVIA
PARAGUAY
Pacific Ocean
CHILE
Atlantic Ocean
ARGENTINA
URUGUAY
The Americas


Western Europe
ICELAND
North Atlantic Ocean
NORWAY
SWEDEN
FINLAND
North Sea
DENMARK
IRELAND
U. K.
NETHERLANDS
GERMANY
BELGIUM
LUX.
SWITZERLAND
AUSTRIA
FRANCE
PORTUGAL
SPAIN
ITALY
Black Sea
GREECE
Mediterranean Sea
CYPRUS
MALTA


Eastern Europe
ESTONIA
Baltic Sea
LATVIA
LITHUANIA
(RUS.)
BELARUS
RUSSIA
POLAND
UKRAINE
CZECH REP.
SLOVAKIA
KAZAKHSTAN
MOLDOVA
HUNGARY
ROMANIA
SLOVENIA
SERBIA
CROATIA
BULGARIA
Black Sea
ARMENIA
AZERBAIJAN
ALBANIA


Middle East & North Africa
MOROCCO
ALGERIA
TUNISIA
Mediterranean Sea
LIBYA
EGYPT
TURKEY
Black Sea
SYRIA
LEBANON
ISRAEL
IRAQ
IRAN
JORDAN
KUWAIT
BAHRAIN
QATAR
UAE
SAUDI ARABIA
OMAN
YEMEN
SUDAN
MAURITANIA *
Arabian Sea
Indian Ocean
IRAQ
KUWAIT
SAUDI ARABIA
BAHRAIN
* Countries marked with an asterisk are among those to be added to ICRG in 2011


MALI
NIGER
SENEGAL
GAMBIA
GUINEA BISSAU
GUINEA
SIERRA LEONE
LIBERIA
COTE D'IVOIRE
BURKINA FASO
GHANA
TOGO
NIGERIA
CAMEROON
EQUATORIAL GUINEA *
SAO TOME & PRINCIPE *
CENT. AFR. REP. *
GABON
CONGO REP.
(ANGOLA)
CONGO, DR
RWANDA *
BURUNDI *
UGANDA
KENYA
TANZANIA
ERITREA *
DJIBOUTI *
ETHIOPIA
SOMALIA
Indian Ocean
ANGOLA
ZAMBIA
MALAWI
MOZAMBIQUE
ZIMBABWE
NAMIBIA
BOTSWANA
SOUTH AFRICA
MADAGASCAR
Atlantic Ocean
Sub-Saharan Africa
* Countries marked with an asterisk are among those to be added to ICRG in 2011


GEORGIA *
Caspian
Sea
Aral Sea
UZBEKISTAN *
TURKMENISTAN
KYRGYZ REP. *
TAJIKISTAN
CHINA
AFGHANISTAN *
PAKISTAN
NEPAL *
Persian Gulf
Gulf of Oman
INDIA
BANGLADESH
Arabian Sea
Red Sea
Asia & Pacific
Bay of Bengal
Gulf of Aden
Indian Ocean
SRI LANKA
* Countries marked with an asterisk are among those to be added to ICRG in 2011


MONGOLIA
Sea of Japan
NORTH KOREA
SOUTH KOREA
JAPAN
Yellow Sea
North Pacific Ocean
CHINA
INDIA
NEPAL *
East China Sea
TAIWAN
MYANMAR
HONG KONG
LAOS *
BANGLADESH
Bay of Bengal
THAILAND
South China Sea
Philippine Sea
PHILIPPINES
VIETNAM
CAMBODIA *
BRUNEI
MALAYSIA
SINGAPORE
PAPUA NEW GUINEA
Java Sea
INDONESIA
Asia & Pacific
TIMOR-LESTE *
Arafura Sea
Timor Sea
* Countries marked with an asterisk are among those to be added to ICRG in 2011
AUSTRALIA
Coral Sea

Source: The PRS Group, Inc, 2011

Annex 20: Global proved conventional gas reserves, by country

ank	Country	Natural gas - proved reserves (cubic meters)
1	Russia	44,800,000,000,000
2	Iran	29,610,000,000,000
3	Qatar	25,370,000,000,000
4	Saudi Arabia	7,807,000,000,000
5	United States	7,716,000,000,000
6	Turkmenistan	7,504,000,000,000
7	United Arab Emirates	6,453,000,000,000
8	Nigeria	5,292,000,000,000
9	Venezuela	5,065,000,000,000
10	Algeria	4,502,000,000,000
11	Iraq	3,170,000,000,000
12	Australia	3,115,000,000,000
13	Indonesia	3,001,000,000,000
14	Kazakhstan	2,407,000,000,000
15	Malaysia	2,400,000,000,000
16	Egypt	2,186,000,000,000
17	Norway	2,039,000,000,000
18	Uzbekistan	1,841,000,000,000
19	Kuwait	1,798,000,000,000
20	Canada	1,754,000,000,000
21	Libya	1,548,000,000,000
22	Netherlands	1,387,000,000,000
23	Ukraine	1,104,000,000,000
24	India	1,074,000,000,000
25	Oman	849,500,000,000
26	Azerbaijan	849,500,000,000
27	Pakistan	840,200,000,000
28	China	800,000,000,000
29	Yemen	478,500,000,000
30	Trinidad and Tobago	408,200,000,000
31	Brunei	390,800,000,000
32	Argentina	378,800,000,000
33	Colombia	377,000,000,000
34	Brazil	366,400,000,000
35	Peru	345,500,000,000
36	Mexico	338,800,000,000
37	Thailand	312,200,000,000
38	Angola	309,800,000,000
39	Burma	283,200,000,000
40	Bolivia	281,500,000,000
41	United Kingdom	256,000,000,000
42	Syria	240,700,000,000
43	Papua New Guinea	226,500,000,000
44	East Timor	200,000,000,000
45	Israel	198,200,000,000
46	Bangladesh	195,400,000,000
47	Vietnam	192,500,000,000
48	Germany	175,600,000,000
49	Poland	164,800,000,000
50	Cameroon	135,100,000,000
51	Mozambique	127,400,000,000
52	Ethiopia	113,000,000,000
53	Denmark	101,000,000,000
54	Philippines	98,540,000,000
55	Chile	97,970,000,000
56	Bahrain	92,030,000,000
57	Congo, Republic of the	90,610,000,000
58	Sudan	84,950,000,000
59	Cuba	70,790,000,000
60	Tunisia	65,130,000,000
61	Italy	63,570,000,000
62	Romania	63,000,000,000
63	Namibia	62,290,000,000
64	Rwanda	56,630,000,000
65	Korea, South	50,000,000,000
66	Afghanistan	49,550,000,000
67	Serbia	48,140,000,000
68	Equatorial Guinea	36,810,000,000
69	New Zealand	34,380,000,000
70	Croatia	31,580,000,000
71	Cote d'Ivoire	28,320,000,000
72	Mauritania	28,320,000,000
73	Gabon	28,320,000,000
74	Ghana	22,650,000,000
75	Japan	20,900,000,000
76	Austria	16,140,000,000
77	Slovakia	14,160,000,000
78	Uganda	14,160,000,000
79	Ireland	9,911,000,000
80	Georgia	8,495,000,000
81	Hungary	8,098,000,000
82	Ecuador	7,985,000,000
83	France	6,796,000,000
84	Tanzania	6,513,000,000
85	Taiwan	6,229,000,000
86	Turkey	6,173,000,000
87	Jordan	6,031,000,000
88	Kyrgyzstan	5,663,000,000
89	Bulgaria	5,663,000,000
90	Somalia	5,663,000,000
91	Tajikistan	5,663,000,000
92	Czech Republic	3,964,000,000
93	Guatemala	2,960,000,000
94	Belarus	2,832,000,000
95	Spain	2,548,000,000
96	Morocco	1,444,000,000
97	Benin	1,133,000,000
98	Congo, Democratic Republic of the	991,100,000
99	Greece	991,100,000
100	Albania	849,500,000
101	Barbados	113,300,000
102	South Africa	27,160,000
103	Macau	174,000
104	Moldova	0
105	Mongolia	0
106	Montserrat	0
107	Malawi	0
108	Montenegro	0
109	Macedonia	0
110	Mali	0

Source: http://www.indexmundi.com/g; Oil and Gas Journal 2011 & 2012

END OF THE DOCTORAL THESIS